Geoscience Online

5th National Forum
information management in the geosciences

5th National Forum on Information Management in the Geosciences

CSIRO Discovery Centre, Canberra, 28-29 March 2001

Fifth National Forum on Information Management in the Geosciences: Geoscience OnLine

28-29th March 2001, Canberra

Preface and Acknowledgements

This was the fifth in the series of successful Forums on geoscience information management that have been held in Canberra since 1993. With the growing use of the Internet for access and delivery of data and services, it is timely to address issues relating to the provision of geoscience online. The Forum provided the opportunity to learn about the latest trends and developments in the exciting and growing area of Internet and web technologies for the delivery of online information.

The Forum was well attended, with 140 registrants and 28 speakers over the 2 days. As well there was were trade exhibitors who provided the opportunity for attendees to view the latest in online technology products.

AGSO, along with state geological agencies presented their online data delivery initiatives. There was a range of speakers dealing with the online delivery of spatial geoscience data, from geoscience-related vendors through to the latest developers in web technology.

The geoscience sector is on the cusp of leveraging the potential of online delivery. Over the past 5 years most government agencies have focused on improving their data management practice and cleaning up their datasets, so that their "backend" is in good shape to support online delivery. Some have implemented online delivery and eCommerce systems (GIS, image processing and database access) already, but uptake is uneven across the sector and such systems generally only deliver the lower volume, less commercially sensitive datasets.

In the private sector we have begun to see the emergence of commercial data management consultants who are providing web based access to their clients, and, within the larger companies, some sophisticated Intranet solutions are now operating. A small number of players are looking at providing online value-added services for clients like share market investors (mining/petroleum shares).

My thanks to the Forum organising committee and the presenters for providing yet another first class event. What form a sixth Forum will take will be very much influenced by the technology and the shape of the industry in 2003 – I look forward to this time with a sense of anticipation.

Editor's Comment
This CD is a compilation of abstracts and associated PowerPoint presentations and papers that were presented at the Forum. The Presentations and papers are unedited and are therefore provided 'as is' on the CD. Email and web addresses have been included in author's titles where available.

Acknowledgements

The Forum coincides with the biennial meeting of the Government Geologists Information Policy Advisory Committee (GGIPAC), who act as patron for the Forum. GGIPAC wishes to thank the organising committee whose effort contributed to the success of the Forum.

Ian O’Donnell, GGIPAC Convener

Program

Wednesday 28th March

Welcome and Chair of Opening Session: Trevor Powell

9.00-9.15	**Opening of Forum**, *The Hon Warren Entsch MP, Parliamentary Secretary, DISR*
9.15-10.00	**Keynote Address**, **Managing the Enterprise in an On-Line World** *David Barbagallo CEO, CRC for Enterprise Distributed Systems Technology*

Session 1 Geoscience Agency Reviews Chair: Ian O'Donnell

10.00-10.15	**State Review – Geological Survey of NSW - geoscience information management** *Peter Lewis, Geological Survey of NSW*
10.15-10.30	**The progression to geoscience information online at the Queensland Department of Mines and Energy** *John Tuttle, QLD Dept Mines and Energy*
10.30-10.50	*Morning Tea*
10.50-11.05	**Geoscience online in the Geological Survey of Western Australia** *Stephen Bandy, Geological Survey of WA*
11.05-11.20	**Receipt, processing and distribution of digital data at the Office of Minerals and Energy Resources, South Australia** *Greg Jenkins, Office of Minerals and Energy Resources, SA*
11.20-11.35	**Online geoscience information in Victoria** *Alan Willocks, Geological Survey of Victoria*
11.35-11.50	**Review of information management activities within the NT Geological Survey** *Tracey Rogers, NT Geological Survey*
11.50-12.05	**Mineral Resources Tasmania: Geoscience information management - a whole of government approach** *Peter Rice, Mineral Resources Tasmania*
12.05-12.20	**Information Management in AGSO** *Trevor Powell, ASGO*
12.20-12.30	**Discussion**
12.30-13.30	*Lunch*

Session 2 Web Delivery Systems – I Chair: Lesley Wyborn

13.30-13.55	**Spatial Databases for the Enterprise** *Eve Kleiman, Oracle Corp*
13.55-14.20	**ArcGIS - One world. One GIS** *Adam Hender, ESRI Australia*
14.20-14.45	**Breakdown the barriers to the decision making process:Online access to 'information rich' imagery and associated data** *Peter Weston, Earth Resource Mapping*
14.45-15.10	**Intierra: A multidisciplinary approach to geoscience knowledge management online (in a commercial environment**) *P Smith and DF Pridmore, Intierra Pty Ltd*
15.10-15.30	*Afternoon Tea*

Session 3 Web Delivery Systems – II Chair: Frank Brassil

15.30-15.55	**Geospatial Fusion Services** *Rob Atkinson, Social Change Online*
15.55-16.20	**Earthinsite.com – turning images into online products** *Prame Chopra and John Payne, Earthinsite.com Pty Ltd*
16.20-16.45	**NW Queensland Mineral Province Study Report – Interactive CD product** *Adam Hender, ESRI Australia and John Tuttle, QLD DME*
16.45-17.10	**Veritas Gold - an online window to Australian exploration data** *David Bush, Veritas DGC Australia*

17.10-17.30 **Discussion**
17.30-18.30 *Cocktail Function, CSIRO Discovery Centre*
19.00-22.00 *Dinner, Rydges Lakeside Hotel*

Thursday 29th March

Session 4 Web Delivery Systems – Government Chair: Jonathon Root

9.00-9.25 **DIGS an information delivery vehicle on the Web**
Geoff Brookes, NSW Dept Mineral Resources
9.25-9.50 **Developing a GeoServer for delivering geoscience spatial data online for Primary Industries and Resources, South Australia**
Ian Overton et al, Mapping and Beyond Pty Ltd
9.50-10.15 **Web based mapping, GIS and image processing: the AGSO perspective.**
Tim Mackey, AGSO
10.15-10.40 **Australian Survey and Land Information Group (AUSLIG): AUSLIG Information Management and Distribution**
Alister Nairn, AUSLIG
10.40-11.00 *Morning Tea*

Session 5 Data Transfer and Standards - I Chair: Geoff Lawford

11.00-11.25 **PDF - A "Pretty Damn Fine" way to deliver GIS products online**
Ian Miller, SpatialVision
11.25-11.50 **XML for geoscience data - a key piece in the online puzzle**
Simon Cox, CSIRO Exploration and Mining
11.50-12.15 **Suitability of SVG for online geospatial applications**
Ross Ackland, CSIRO Spatial Information Systems
12.15-12.30 **Discussion**

12.30-13.30 *Lunch*

Session 6 Data Transfer and Standards – II Chair: John Creasey

13.30-13.55 **E-business in spatial data: Policy and legal issues**
George Cho, University of Canberra
13.55-14.20 **Towards an Australian Disaster Information Network (AusDIN)**
David Johnson, Earthware Systems (Aust) Pty Ltd
14.20-14.45 **Report on GGIPAC**
Ian O'Donnell, AGSO
14.45-15.10 **"Online Initiatives" in the E & P service sector**
Tony Blunden, Geoquest
15.10-15.30 *Afternoon Tea*

Session 7 Future Developments Chair: Ian O'Donnell

15.30-15.50 **Online geoscience information: where to next?**
Jonathon Root, AGSO
15.50-16.30 **Panel Discussion Session**
16.30-16.35 **Closing of Forum**
Ian O'Donnell, AGSO

Managing the Enterprise in an On-Line World

David Barbagallo
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Mr Barbagallo will examine some of the issues facing organisations as they grapple with pervasive computing. He will highlight the challenges for enterprises wanting to be connected, competitive and profitable. Will devices increasingly become a key element of business infrastructure in Australia? Will wireless technologies finally deliver on their claims for data intensive environments? Finally he will make a brave attempt to predict where the Internet industry will be in 3 years.

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Geoscience Agency Reviews

State review - New South Wales Department of Mineral Resources
Geoscience Information Management

www.minerals.nsw.gov.au

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Department of Mineral Resources – Status of Strategic Plans

The Department has completed implementation of the information systems strategy devised in 1994 and amended 1995. This involved the development of an infrastructure for normal business applications over a LAN and to allow core business groups to build corporate data models and applications. In the last three years the leading IM/IT State agency (DITM) has been encouraging Departments to provide services over the web. The DMR is in the process of meeting this goal. To date however with the exception of the DIGS application no live data transactions take place and e-commerce activity is in its embryonic stages. TAS on the Net is scheduled to go live at the end of February 2001. This application will permit licence applications and enquiries about existing titles. No spatial query tool is present on line. On line delivery of spatial data is under consideration. There are concerns over the delivery of data given current line speeds. This is likely to remain a factor for several more years as infrastructure is built unless new technology such as wireless/satellite communication proves to be an effective delivery tool.

There are four major subsystems operating over the Departmental WAN: COGENT/DIGS, TAS, COMET and the Office Administration applications. The COGENT/DIGS system handles geoscience data for the Geological Survey.

Geological Survey – Current Activities / Plans

The NSWGS is at the crossroads in its development cycle. Most of the important business processes have been reviewed during the COGENT contract period and their data-models upgraded . A serious attempt is being made to re-engineer the process of mapping, interpretation-compilation and map production. Most core corporate data, with the exception of geophysics and cartography are uploaded into a corporate data-model (currently into Oracle tables). There is provision for upload of map data in the coming months but geophysical data warehousing needs attention.

Routine work is supported by an Oracle-SDE setup configured to deliver point and vector data to current viewers (ArcView 3.2) as shape files or coverages. Customised extensions have been prepared for ArcView to streamline downloading of current SDE layers to client PC's. Preparation of regional, map sheet and district GIS packages continues for Exploration NSW and GS products but there will be a progressive move to Statewide layers that can be cookie-cut.

Databases: Data custodians maintain the current core corporate data including resource data, geochemistry, drilling, seismic information. Most are near complete. The stream geochemistry and drilling data are in an advanced state (85-95%) and will be close to completion this year. Validation of drill data is ongoing and will take another year to complete. Note that a major update of the industrial minerals data set is underway. Storage, network and backup issues have caused some problems for routine COGENT data maintenance.

DIGS: The DIGS imaging system is operating at a satisfactory level, the highlight being the launch of the application onto the internet last year. (see separate paper this volume for details) There is a current project to add a spatial query tool to DIGS to provide access to the COGENT data tables especially drilling, historic titles and possibly geophysical survey areas.

A major shift in strategy for the delivery and promotion of data is to consider the use of summary or meta-data tables as a link to source data held in DIGS. This reduces the work of data collection but also has the effect of reducing functionality for analytical work.

Geodata Modelling: The NSWGS is assessing its options in respect of a Geodata Model and its move to ArcSDE 8. As a first step we will conduct a project to produce a State-wide data set for digital geology by creating a "simple feature model". A more complex model is a matter for national debate and the NSWGS supports the concept of a national standard for a "geodata template" in the future. It is anticipated that this will become an ongoing issue for GGIPAC.

New Management Structure: A new group has been established within the NSWGS to handle existing information systems and to manage IT/IM related projects. It combines GIS – DIGS and COGENT data-warehousing functions. Funding is being provided from the new exploration initiative, Exploration New South Wales.

GDA: Our planning for conversion to the GDA is complete. Conversion of data and data capture procedures are underway. We would advise all users to check the meta-data of projection type of our products for the coming period.

Digital Reporting: Submission of exploration reports in digital format, under national guidelines, is now a requirement. This is operating without many problems to date. As a result the costs for scanning hard copy into DIGS is less than predicted.

Web Pages:

The NSWGS has prepared a new set of web pages for inclusion in the Department's site. These pages are intended to be the major outlet for presenting existing data, current activities, new products and for distributing updated material.

Forward Plans (1-3 years)

The plans for the next three years are constrained by budget and technology issues. A tight budget regime will be in place for period ahead. Applications and projects must be able to operate within the current architecture provided by the Department. Some policy issues on data delivery, pricing etc remain under review. The distribution of vector and image data via the web is being looked at but there are ongoing concerns over the practicality and value of this function.

New projects and possible projects include.

- Enhancement of DIGS. Addition of a spatial query tool (browser) to DIGS with AVIMS as a map server to the internet. This is a current development project using the Intersect drill data.

- Ongoing development of a geodata (object-oriented-feature) database to established standards. Model to address analytical and graphical functions.

- Revision, semi-automation of meta-data attachments to data sets. Improvements to business practices in data collection, record/version management. This includes an extension of data capture as conducted by the COGENT-compliant mapping teams (with data entry to an observations-sites database) to all relevant field activities.

- Development and adoption of standard metadata tags (tables), when available, to facilitate interaction with a variety of web portals at State and national level.

- Further development of COGENT geoscience datasets, including planning for possible on-line 'live' query of suitable material.

- Development of data warehousing for geophysical data.

- Upgrade to ArcSDE 8. Ongoing development of COGENT Business Process Revision for cartographic/mapping functions.

- Development of projects as a part of the Exploration NSW initiative for data acquisition and information delivery, especially on-line delivery.

- Standard more 'vanilla' template design for GIS packages.

- Increasing use of web pages to promote the agency and distribute new and upgraded material.

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Geoscience Information Online
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Extended Abstract

Access to Geological Survey Office (GSO) geoscience information is being improved through a number of web based initiatives. This geoscience online approach has delivered a range of information styles with information access via interactive queries or focused towards ordering geoscience products. The primary focus is on conveying a spatial overview of Queensland's mineral and energy endowment through a series of GIS based interactive map views. This format is supported by search and query access to library databases for research purposes and click and browse formats for product catalogues and general information. Geoscience online is delivered via the department's intranet and the Internet with the former focused on providing services for internal users and regional office staff. For the Internet, the range of geoscience information (apart from the library databases) is most easily accessed through the GEOSCIENCE INFORMATION INDEX www.dme.qld.gov.au/gsd/index.htm as indicated in slide 7.

GIS Based Interactive Maps

The Interactive Resources and Tenure Maps item on the GEOSCIENCE INFORMATION INDEX page links to the INTERACTIVE MAPS index where the user can choose from a catalogue of views. The GIS based interactive maps are currently delivered through ESRI's ArcViewIMS interface and provides industry clients with a graphical based viewing and querying capability. The main focus is on conveying the mineral and energy endowment of Queensland along with the status of exploration and mining land tenure. Slides 10 to 20 illustrate the type of general and detailed information available within each of the views.

There are four, whole of State views and two regional project views. The State views present information on the minerals, petroleum, coal and the extent of aerial geophysical surveys. The information conveyed includes mineral deposit characteristics, regional geology, exploration tenure, coal resource extents, seismic line surveys and drill details for petroleum wells. The exploration tenure themes are currently updated on a weekly basis and will be updated daily in the latter part of 2001.

A range of interactive tools is provided to display feature information, search for a locality, link to photo images, zoom and pan about the map and print a screen dump of a view. A few of the data themes are also set to display at specific map scales to avoid cluttering a view with too many features. At this stage, the user is unable to download any of the data sets with direct access to the digital geoscience information provided via a range of database and GIS format products.

The current emphasis is on providing the user with enough information to become familiar with Queensland's mineral and energy status and to answer general enquiries. Further detailed information can be accessed in other parts of the web site or by direct contact to the Geological Survey through the Geological Information Hotline. For example, a company report reference included with petroleum well data can be followed up with a query and search in the web form for the openfile company report database (QERI).

The regional project views are built around two earlier promotional GIS products that were distributed on CD. They include the North-West Queensland and Chillagoe-Palmer River and Herberton areas

with the views designed to convey a greater range of summary level geoscience and tenure information against a backdrop of 1: 500 000 scale geology.

Library Databases

The library databases (examples in slides 21-25) are most easily accessed through the PRODUCTS, SERVICES AND PUBLICATIONS INDEX www.dme.qld.gov.au/prodindx.htm. The search and query access function is implemented via a HTML form and includes the ability to search by words anywhere, words in title or author. The databases (slide 22) most applicable to exploration data research are those for openfile company reports (QERI) and the commodity files (COMM). The search results are given at a summary level with no direct online access to the relevant report. The approval and implementation of the digital company reporting system will eventually provide online access to the exploration reports but at present, the user has to visit the library and view the microfiche records. References to old mine plans and library books and journal literature index databases are also available for searching.

Product catalogues and Static Text

The product catalogues and information bulletins are HTML driven with this information (examples in slides 26-35) accessed through the Geoscience Products link in the GEOSCIENCE INFORMATION INDEX page. The links take the user down one or two levels with product descriptions and prices. The map catalogue is designed around a regional map sheet index superimposed on a map of Queensland. Again the user clicks down a number of levels to the actual list of maps, formats and prices.

Future Developments

The ArcIMS interface is currently being trialed on the Mines intranet. Once the software has been tested fully in this environment it will be migrated to the Internet to replace the ArcView IMS version. An advanced multi window ArcIMS product (slides37-38) has recently been developed on CD (Java format delivery) for a project in the State's North-West Minerals Province. Some of this project's views will be the first deployed in the new ArcIMS web interface via the html format of view delivery.

Other future initiatives include the online deployment of the Department's MERLIN tenures system and the digital, exploration company reports system. The ability to conduct e-commerce transactions based around the IMS interface is also under consideration.

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Geoscience Online in the Geological Survey of Western Australia

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Information is a valuable resource and the Geological Survey of Western Australia (GSWA) continually seeks ways to ensure geoscientific data are accurate, up-to-date, and easily accessible. In addition, the use of the World Wide Web (WWW) will become an increasingly important means of visualizing, manipulating and extracting information stored in databases to meet specific user needs.

In June 2000 the Western Australian Government released its "Online WA 2000" policy, a strategic document outlining the government's plan for embracing new technologies. The document states Western Australia's commitment to "improving government service delivery through enabling the adoption of online service delivery."

In line with this strategic direction, GSWA information systems, databases and infrastructure will be designed to support timely and reliable remote access via a variety of media with special emphasis on the WWW. GSWA is now re-engineering its product development processes and reviewing information management policies to ensure that customers are provided with the timely delivery of integrated and accessible geoscientific data.

Critical to the delivery of online geoscientific data is the development of GeoBASE.WA as a framework to integrate aspatial and spatial data such that there is access to a single source of all GSWA data in one database management system environment.
Current and future online developments to improve the ease of access to GSWA's data repository include:

Current:
E-Bookshop – Purchase of books and maps produced over the last 100 years using secure online credit card purchase
GeoVIEW.WA – An ArcIMS Internet application that provides an integrated view of GSWA's integrated geoscientific data
WAPIMS – An ArcIMS Internet application providing access to an index of petroleum reports and available data in onshore and offshore WA
MAGIX – An ArcIMS Internet application providing access to an index of airborne geophysical surveys in WA
WAMEX – Internet access to an index of open-file statutory mineral exploration reports

Future:
E-Bookshop – provision of a graphical search tool, inclusion of abstracts and provision of manuscripts in PDF format
GeoVIEW.WA – provision of a map compilation and generation function
MINEDEX – Internet access to mineral resource information in WA
WAMEX – provide functionality to view open-file statutory mineral exploration reports.

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Receipt, processing and distribution of digital data at the Office of Minerals and Energy Resources, South Australia

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For a number of years, South Australia has had a mature but dynamic database for maintenance of geoscientific data of various types. Rapid advances in database technology and in methods of using and interpreting the data have demanded batch processing of large volumes of data rather than the traditional processing of single or small numbers of records.

The implementation date for digital reporting of mineral exploration data in South Australia was 1 January 2001. The process is based on the National standard established in collaboration with the geoscience agencies of other Australian jurisdictions through GGIPAC. For the first year, one digital and one hardcopy report will be required. The process will be reviewed at the end of that time with a view to requiring digital reporting only. In the longer term, digital reporting is expected to significantly reduce the amount of manual processing required by both exploration companies and Office of Minerals & Energy Resources (MER) staff. This applies to both receipt of exploration reports and delivery of open file data to clients.

The current system of receipt of mineral exploration reports includes scanning of the documents prior to archiving of the originals, replacing microfiche storage. The historic backlog of hardcopy reports is being scanned as rapidly as current resources allow.

Delivery of data to clients has relied on the provision of static snapshots of databases on various media, principally CD-ROM. That type of data supply will remain available for as long as a demand exists. On-line data delivery through a Web browser interface to a server-driven GIS has obvious advantages, and is currently being implemented through the GeoServer project. The Mineral Exploration Tenements Application (META) module will allow on-line examination of areas available for exploration. On-line tenement application is to be made available. The Mining Industries GeoServer (MIGS) module is to allow on-line access to GIS data through a thin-client (server driven) interface. ArcIMS is the software most likely to be used. Initially, basic GIS viewing and querying functions will be provided through image service. At a later stage of development, feature server and/or extract server capabilities may be made available to registered users.

E-commerce services are being established at whole of Government level through the Bizgate program. Those services will be used by META and MIGS.

Provision of detailed imagery through ERMapper's Image Web Server is being evaluated.

Selected broad scale geoscientific data is currently available for viewing and querying from a GIS server at http://www.atlas.sa.gov.au . The site was established as a pilot for whole of Government delivery of Web mapping services at regional scale.

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Online Geoscience Information in Victoria

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Minerals and Petroleum Victoria (MPV), a division within the Victorian Department of Natural Resources and Environment (NRE) manage geoscience information. With over 4000 staff in 10 divisions, NRE has a wide range of data systems and expertise and a large resource pool. NRE has an opportunity to coordinate the implementation of new technology to the mutual benefit of all its businesses. Coordination of this effort will enable NRE to achieve economies of scale and significant cost savings, while also enabling NRE to position itself with a corporate and modern Internet based geospatial technology. Within this structure MPV is playing an important part in developing strategic directions in data infrastructure, electronic document management and web mapping.

Spatial geoscientific (geospatial) information is crucial in achieving the objectives of the various business programs. The development of Landview spearheaded by MPV, was the first step in providing an integrated intranet web mapping tool to access data and products. Using this technology, first generation applications have been customised by other divisions to disseminate geospatial information in the form of on-line maps to their staff and clients. NRE is committed to improving the on-line viewing and delivery of geospatial data. The Department recognises that web access to this information is essential to its clients. So it is developing a generic web browser-based mapping application known as NR***e-map*** to support Internet-based projects as well as NRE intranet-based projects.

The availability of geoscience information on website http://www.nre.vic.gov.au/minpet has improved substantially over the last 12 months. The site themes now cover mining history, exploration licence information, geological mapping project status, historical information, mineral notes, status of exploration as well as products & services. On-line order forms (and on-line ordering in some instances) and report abstracts are currently available. NRE is committed to improving the on-line viewing and delivery of geoscientific data.

In recent years, significant investment has been made by the Government through Land Information Group to develop the core framework information components of this Internet based geospatial technology under the Victorian Geospatial Information Strategy. The focus has been on the geodetic network, land parcel/property, road network and topographic information. The recent Information Infrastructure Initiative will increase the framework information by developing the four datasets of administrative boundaries, hydrographic, elevation (DEMs) and imagery. A key feature will be the extension of the coverage of this data to the whole of Victoria. It will benefit MPV, as the data provided is capable of supporting a variety of initiatives and responsibilities including providing basemap information for geoscience applications and for web access using NRe-map.

An NRE corporate objective is to improve the management of electronic documents and the utilisation of their content. To achieve these goals, NRE has commenced an Electronic Document Management System (EDMS) project. An EDMS will be used to assist in applying knowledge and records management practices to both paper (mainly historical) and electronic documents to support NRE's medium to long-term information needs. The EDMS will aid in increasing and maintaining the corporate memory, and providing a central document repository to support knowledge management and e-business initiatives. Links will be made to enable storage of digital exploration licence reports and data, ultimately leading to open-file data being available across the web.

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Review of information management activities within the NT Geological Survey

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Following in the footsteps of other state Surveys the Northern Territory Geological Survey (NTGS) has gained significant additional funding for the 1999 – 2003 period through the Northern Territory Exploration Initiative. The majority of the extra funding is directed at increasing the coverage of semi-regional airborne magnetics and radiometrics over the Territory but a portion is allocated for the development of information management systems that support and complement the geophysical program.

Over the last two years the NTGS web site has been redesigned, the Industry Reports Management System (IRMS) and an image web server (IWS) for the delivery of geophysical images have been developed and made available to the public. The focus for delivery of information and data has changed from hardcopy maps and reports to delivery via CD-ROM and increasingly, the Internet. The NTGS web site (www.dme.nt.gov.au/ntgs) is now a major delivery mechanism for many products and has become a dynamic resource for clients with the addition of the Image Web Server and IRMS index. This is a highly desirable and important outcome considering over 90% of NTGS clients are not based in the NT.

The IRMS project has involved scanning all open file mineral exploration reports back to 1983 and providing a web interface to the improved and updated index database. Clients can identify and obtain reports by searching IRMS index on the web and then emailing a request to the Geoscience Information Branch of NTGS. Reports are then copied to CD or emailed depending on size. Although not a priority at present new compression technology and delivery mechanisms are being monitored with a view to providing access to the entire collection of scanned reports over the Internet in the future.

An IWS was purchased and developed during 2000 as a means for clients to access compressed located imagery from 47 semi-regional government geophysical surveys over the Territory. Initially a demonstration version with a limited display of images was uploaded to the web site. In December 2000 the IWS interface was redesigned and over 400 images, including images from surveys flown in 2000, were uploaded to the web site. The IWS is accessed through standard web browsers and with web plugins allows located images compressed using wavelet based compression technology to be displayed in various industry standard software packages by specifying image URLs. Once displayed in one of these packages other GIS layers can be opened and used in conjunction with the imagery.

Many of the new NTGS products are being placed on the web site for download. Such products include digital geological maps, presentations, open file geochemical data sets, the Northern Territory Mineral Deposits database (MODAT) and NTGS Records.

Current projects involving the Geoscience Information Branch include scanning of open file onshore petroleum well completion reports, redevelopment of the core library database (COREDAT), collection of open file geochemistry data in the Arunta Province, development of a GIS package over the Tanami Region and web-enabling the library catalogue. Future plans are focussed in three main areas: web delivery of scanned reports, a web-enabled open file geochemistry database covering the entire Territory, and the development of a spatial interface for NTGS datasets on the web site. Web delivery of open file company reports will include further scanning, namely the pre-1983 mineral exploration and all offshore well completion reports. The compilation phase of the open file geochemistry database project is well under way with complete coverage of the NT projected for mid-2002. The development of a spatial interface for NTGS datasets may proceed in several phases, possibly using the DME Titles Information System (TIS) as a development platform (www.dme.nt.gov.au/tis/olz.asp).

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Mineral Resources Tasmania Geoscience Information Management - A Whole of Government Approach

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The Tasmanian Government is committed to providing better decision support systems for investment in minerals and infrastructure development. Mineral Resources Tasmania, a Division of the Department of Infrastructure, Energy and Resources is combining geoscience data with core land information sourced from across government to improve decision making both within and outside government. The impetus for a whole of government approach has come from a combination of political will, government executive support, and rapid up take of new technology by the work force.

New policy and processes have been created to sustain the new approach, this includes partnership agreements, defining custodianship and setting or adopting agreed standards across state and local government.

Mineral Resources Tasmania has developed a new tenement management system that is compatible with Land Information System Tasmania (LIST) core land information data sets. Tenement information will be available later in 2001 with a variety of geoscientific information from the MRT web site (http://www.mrt.tas.gov.au) but basic tenement and cadastral information is already available from the LIST web site http://www.thelist.tas.gov.au).

MRT and LIST have developed Oracle/SDE replication to move data between sites within government, replication can be scheduled at the desired frequency to update spatial layers from a data custodian. Data directory services for all spatial data have been centralised in the Tasmanian Node of the Australian Spatial Data Directory that is an Oracle implementation of the ANZLIC Page 0 meta data standard.

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Information Management in AGSO

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The Australian Geological Survey Organisation (AGSO) is Australia's national geoscience research and information agency – AGSO is in the geoscience information business. Traditionally much of AGSO's work went towards enhancing Australia's geoscientific information infrastructure in an effort to entice exploration investment. Our role is expanding into the social and environmental fields as the value of geoscientific information to issues such as sustainable resource management and community safety are being recognised. The challenge that comes with our existing and emerging client base is not only how to improve the access to our expertise and information, but to find ways of presenting geoscience in such a way that it can be applied to decision-making by non-geoscientists.

AGSO's report to the Forum focuses on our Information Management Strategy for the period 2000 to 2003. This incorporates a range of initiatives designed to create and manage our information more efficiently, strategies for valuing the knowledge infrastructure, as well as improving access to and presentation of our geoscience to a broadening client base. However, capturing the efficiencies and synergies inherent in digital information management can only be achieved through cultural change. Central to this is the continuing development of our online environment in order to make our information and services more widely usable and accessible. Online credit card processing facilities are now part of the Sales Centre and Data Repository operations and online delivery is now in available for a select range of items.

The foundation of AGSO's IM strategy is an Enterprise Information System (EIS). This virtual warehouse linking all of AGSO's information, both spatial and aspatial will be structured to respond to basic as well as the complex geoscience related queries. Client access to geospatial information will be improved through the use of online mapping tools. The linking of all data and information into an EIS requires the development and application of internally consistent corporate standards and definitions for all our data and information types. However, perhaps the most significant task is the need to align the culture and work practices of our staff to the new way of operating. Only then will we be able to achieve the full potential of modern information management and on-line delivery

The report goes on to discuss AGSOcat, the metadatabase of AGSO's information assets, procedures for maintaining consistency and quality of information, the introduction of electronic document management and the strategy for unifying the national geoscience databases through a single sites table.

Our ability to effectively manage knowledge in conjunction with information is the challenge for the future. Harnessing of this intellectual capital will play an increasingly important part in AGSO's ability to efficiently deliver against its business outcomes and outputs. It will also be the cornerstone of our transition into new areas, and allow us to effectively integrate with emerging national and international information infrastructures.

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Web Delivery Systems-I

Spatial Databases for the Enterprise

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GIS is evolving from a thick client, single-user application to a multi-tiered, enterprise-wide technology bringing the "location awareness" to many traditional applications. The popularity of World Wide Web has also increased the popularity of the GIS by bringing “Geographic Information” to every day applications .

These applications require that the spatial data be managed in a database server with the rest of the non spatial data. Storing and managing spatial and non-spatial data in a single database server makes the data integration and data management tasks easy to perform. This makes it easy to spatially enable applications that can potentially have location information.

In this talk, I will present the current state of the Oracle database and show how it can help GIS applications. I will also discuss what the next generation of the Spatial capability within the Oracle Database will offer.

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ArcGIS - One World. One GIS.

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ArcGIS is ESRI's scalable web enabled system of software for geographic data creation, management, integration, analysis, and dissemination for every organisation, from an individual to a globally distributed network of people.

ArcGIS Desktop
The 8.1 release of ArcGIS meets the ESRI plan for a single, scalable software architecture. As a result, ArcView and ArcInfo have merged into a single, integrated platform with a new deployment option known as ArcEditor positioned between them. These clients set a new standard in capabilities of desktop GIS systems for Geoscience users, particularly in the powerful new raster handling tools.

ArcGIS Application Services
The rich offering of ArcGIS Desktop is complemented by two application services: ArcSDE software, for storing and managing data in a multiuser environment, and ArcIMS software, for distributing GIS data and services across the Internet.

ArcIMS is a powerful Internet mapping system that provides a framework for centrally building and deploying GIS services and data. Using ArcIMS, you can deliver focused, lightweight GIS applications and data to many concurrent users, both within your organization and externally on the World Wide Web.

Spatial services offered by ArcIMS include map (image) services, feature (streaming vector) services, geocoding location services, spatial database query services, and spatial data extraction or clipping services. ArcIMS Web clients complement the ArcGIS Desktop software and include browser-based viewers (HTML and Java) and stand-alone ArcExplorer viewers (Windows and Java). In addition, ArcPad software, ESRI's mobile mapping solution, can retrieve maps from ArcIMS using wireless technology.

ArcIMS allows a new and dramatic architecture supporting dynamic integration of loosely coupled (Intranet/Internet) GIS clients and servers. This architecture allows clients to integrate local GIS data with ArcIMS layers served from multiple Web sites. This "data fusion" is revolutionising the use, scope, and impact of GIS. Geographic data providers using ArcIMS to publish live maps, downloadable data, and geoservices can register their sites on the Geography Network.

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Breakdown the barriers to the decision making process: Online access to 'information rich' imagery and associated data

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Image file size is no longer a barrier to distribution of geo-scientific image information over the internet. However, the dilemma for information managers is how an organisation manages their data, its distribution and value add to the immense visual information. Notably, an access driven increase in imagery has increased the demand for web deployed solutions which incorporate images and simplify decision making. Accessing the wealth of visual information implicit in geo-scientific images over the web coupled with the ability to deploy this information to thousands of concurrent users is now a reality, and a cost effective one. Firstly, the wavelet compression provides a benefit – reduced hard disk space requirement and consequently a dollar saving in hardware. Secondly, 'streaming' the compressed imagery over the internet to thousands of concurrent users drastically reduces the server requirements and hence further dollar savings. Thirdly, distribution is centralised and distribution costs are negligible.

The second phase of image serving solutions is data integration. Web GIS systems serve vectors, integrate with databases and have sophisticated data querying capacity, however their raster handling capabilities are not impressive. Frequently however, the image provides the key information the user is after. The solution, a smart 'client side browser' delivery system from a 'light server' environment. The ultimate is an integration with web GIS applications eg, E.S.R.I's ArcIMS, MapInfo's MapXtreme or a tailored metadata indexing GIS solution. Furthermore, all this must be provided to the client in a flexible, easy, browser based environment that doesn't require the user to learn new software. In this light, Earth Resource Mapping Ltd will reveal its latest developments for the Image Web Server and associated technology.

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Intierra: A multidisciplinary approach to geoscience knowledge management online (in a commercial environment)

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Geoscience Information, whether it is geological, geophysical, bibliographic, or geomorphological, is merely information until it can be put in a form and context where decisions can be made based on the information. In this environment the information becomes knowledge. In many instances the people collecting the information had the knowledge, but having the information on its own and out of context doesn't guarantee that you will inherit that knowledge. By correctly managing the way information is captured, stored and presented we are not just managing information but managing the knowledge that has been painstakingly collected by those that have gone before us.

Historically the resource industry has been ineffective at managing data, let alone managing information and knowledge. The knowledge management issues in the resource industry are exacerbated by the need to deal with information that is inherently spatial. Moreover stakeholders in the natural resources industry (i.e. investors, exploration companies), also rely heavily on time sensitive information such as ASX announcements, leases, legal proceedings etc.

Intierra is a new business formed to deliver a premium information service over the Internet to clients having a requirement for competitive and timely access to relevant, in-depth and up to date information for the resources sector in a spatial context.

Intierra being a commercial organisation is not limited by political boundaries, or mandated areas of operation. Its objective is to empower its subscribers with knowledge on which they can act promptly and derive a competitive advantage. It is for this reason that Intierra gathers multidisciplinary information outside of the standard geoscience "halls of knowledge". Intierra subscribers can place geoscientific data in a spatial context with Company announcements, native title claims, tenure, and infrastructure.

As an example, consider the announcement by a junior exploration company, which has intersected mineralisation in some drilling that, will have a significant impact on its share price. The first thing you want to know is, where is this new find located, is it near any historical workings, what is the local geology, who has leases along strike, when are they due for relinquishment, are there any geophysical or geochemical signatures over the mineralisation, what is the local infrastructure, will native title be an issue, can I find out more information about the company involved etc?. All of these questions refer to particular pieces of information, which on their own are merely pieces of information, but when placed in an environment where they can be viewed and interrogated in context, decisions can be made, and knowledge is gained.

It is our opinion that Internet based delivery of properly managed and presented geoscientific data, information and knowledge will be seen as one of the most significant developments in technology for the resource industry.

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Web Delivery Systems-II

Geospatial Fusion Services

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Geospatial Fusion Services are an important step forward toward integrating GIS and mainstream IT. Vendors from all over the world are working together with the Open GIS Consortium in developing open standards for components such as Geoparsers, Gazetteers, Geocoders and Web Feature Servers and integrate the results in so-called LOF's (Location Organising Folders).

This presentation explains the high level architecture involved, the benefits of these developments for the geoscience user-community and will give some examples of this emerging technology.

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Earthinsite.com – turning images into online products

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Earthinsite.com brings together all stakeholders in the remotely sensed and GIS data industry including; data providers; value adders and end users of the data. By combining the technology of the Internet with the existing spatial data industry, the uptake and utility of valuable spatial products will be dramatically increased.

Earthinsite.com provides automated processing facilities for the acquisition, harmonisation, generation and dissemination of commercially valuable spatial products. By automating the processing, delivery and commerce of these products, Earthinsite.com can significantly lower the cost to the user. This will drive the take-up of these network services by users because it will negate transport costs, it will minimise delays and importantly, it will put the power of the system directly into the hands of the end-user.

The national infrastructure created that will enable geoscience data providers, value-added service providers, and present and potential users to benefit from the rapid growth of technologies in Earth observation data, services and network systems. This will have considerable economic benefit for many farms and agribusinesses, for mining in regional and remote areas, and will assist the work of Emergency Services, and Land and Water management groups.

Earthinsite.com uses a mix of fast local processing, on the user's computer, and a powerful remote image-processing engine based on the industry-standard ER Mapper™ software. Local processing capabilities are provided by cross-platform Java™ applets. These permit the user to make rapid improvements to the images without the need for Internet traffic. At the back-end of Earthinsite.com is a fully featured image processing system based on custom calls to ER Mapper™. This brings to the user the ability to perform sophisticated image processing and GIS overlays without reliance on specialist software or training.

Earthinsite.com is available on the World Wide Web at http://earthinsite.com. It currently serves 20 Gbyte of Earth data to various classes of on-line users and requires nothing more than an Internet connection and a standard WWW browser.

The market for images is expected to increase almost exponentially as the costs of data reduces and value added products and services become more user-friendly. A whole new class of spatial data users will be created.

The development of systems like Earthinsite.com has the potential to radically transform the use of, and commerce in spatial data but it requires changes in long-held distribution and pricing policies in both the private and public sectors. Some organisations have embraced these concepts more readily than others.

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EXTRACTS FROM DME'S NORTH-WEST QUEENSLAND MINERAL PROVINCE REPORT

Compiled by TJ Denaro, LJ Hutton & PJT Donchak

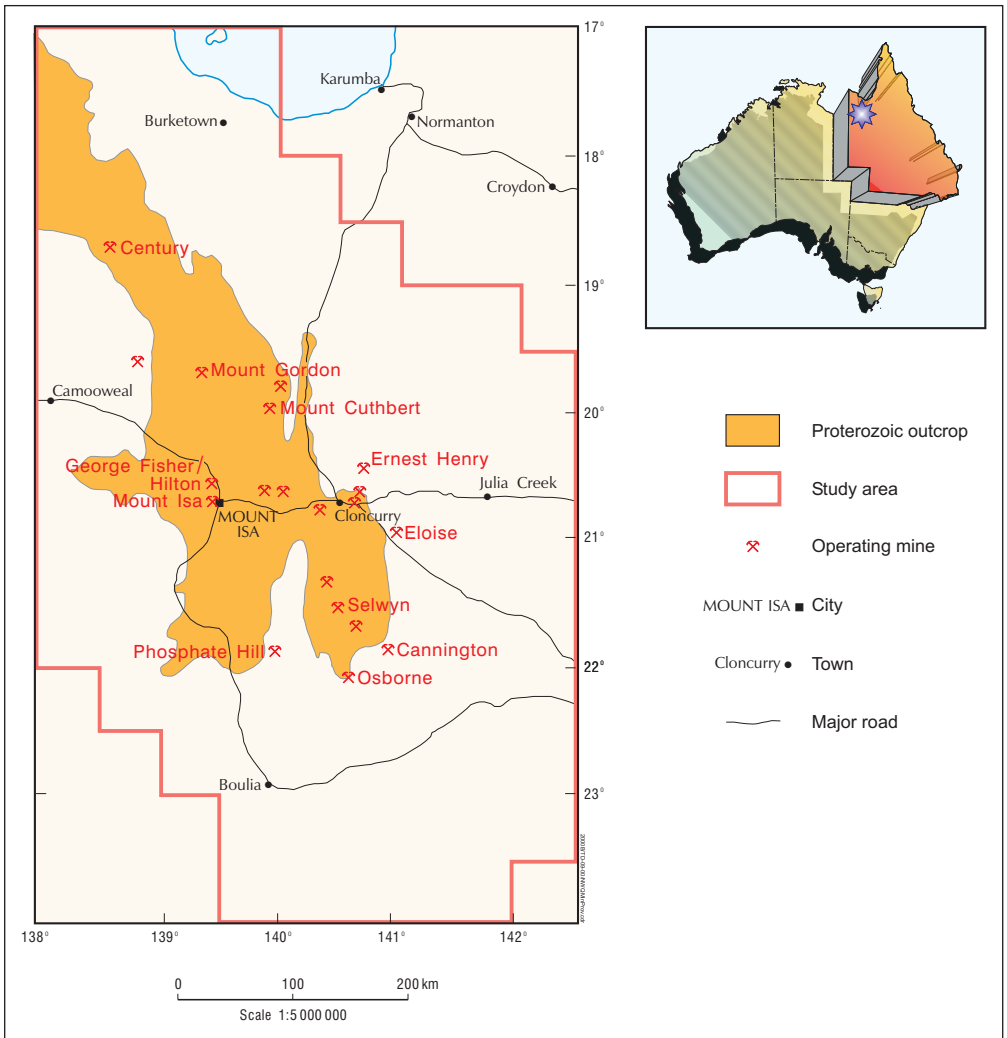
This article was prepared from the North-West Queensland Mineral Province Report produced by the Queensland Department of Mines and Energy, Taylor Wall and Associates, SRK Consulting Pty Ltd, and ESRI Australia and published in the 2001 February edition of the Queensland Government Mining and Energy Journal. The Report comprises a book (from which the following extracts are taken), maps showing suggested targets, a Proterozoic Time-Space matrix, and an interactive CD allowing the user to apply the data used to construct the maps and targets presented in the report. The following texts contain references to tables and figures which are in the Report but have not been included in this extract. Copies of the Report may be purchased and demonstrations of the CD may be arranged by contacting the Department of Natural Resources and Mines (Richie Huber (07) 3237 1511 or Brad John (07) 3235 4068).

INTRODUCTION

The North-west Queensland Mineral Province Study was initiated by the Queensland Department of Mines and Energy (DME) with a view to enhancing the level and effectiveness of exploration activity in the region, through providing fresh insights into its geology, tectonostratigraphic evolution and mineralisation. The primary goal of the project has been to demonstrate that quality, untested targets exist, and therefore that this world-class mineral province should be in the portfolio of all serious mineral explorers.

The Study involved a comprehensive analysis of the area shown, by industry consultants Taylor Wall and Associates and SRK Consulting, in collaboration with senior geological staff from the Department of Mines and Energy. All personnel involved in the Study have previous experience and expertise in the region in company exploration, research work, consulting assignments or Government mapping programmes. Digital data capture, design and production were undertaken by ESRI Australia.

The Study was conducted over the period March to October 2000, using public domain geological, geophysical and geochemical data, the latest research results, proprietary geophysical data made available by MIM Holdings Ltd, and geochemical data provided by Terra Search Pty Ltd.



Location of North-west Queensland Mineral Province Study

The underlying philosophy of the project has been to deliver a knowledge product rather than simply a data package. The emphasis has been on an innovative and accessible interpretation of the geology, the tectonostratigraphic and structural framework, and practical mineral deposit models, leading to robust targeting criteria and target zones. This approach recognises that the key decision points and value-drivers in exploration relate to efficiently identifying and drill-testing the lowest risk targets. It is therefore designed to add real value to the industry by reducing the time and cost to define such targets.

It should be emphasized at the outset that the scale of geological interpretation was 1:250 000, with 1:100 000 in some areas. At this scale, it is generally not possible to define deposit-scale drill targets, so most of the targets are tenement-scale areas and targeting criteria are designed for that scale. However, the mineral deposit models and aspects of the exploration and targeting criteria are applicable at deposit scale, and can be used to design follow-up programs to define and assess drill targets.

Despite the emphasis on interpretation and knowledge delivery, the digital product contains a substantial data/information package, some of which has not previously been in the public domain. In addition there is a particularly comprehensive set of metadata, including links to privately held data that are commercially available from third parties.

The digital product in particular is structured so that all of the information is available to enable the user to independently assess the identified targets, and indeed to generate additional targets. The GIS provides the capability to select, separate and then overlay numerous subsets of the data/interpretation products, and thereby to enable the user to interact with the product in depth.

KEY POINTS

The points summarised below are the major overall highlights for intending mineral explorers in the North-west Queensland Mineral Province.

- The North-west Queensland Mineral Province is a world-class mineral province, with a very attractive spread of commodities and deposit types. It is a major source of the world's zinc, lead and silver output and a significant producer of copper. Most importantly, despite its long history of production and exploration, it hosts a significant proportion of the world's newly discovered (that is, since 1980) zinc, lead, silver and copper resources. The North-west Queensland Mineral Province has continued to produce new world-class base metal deposits at a time of historically low global discovery rates. Most of these resources were under post-mineralisation cover or geologically blind, and were discovered with a combination of sophisticated geological, geophysical and geochemical techniques. This study provides a further advance of information and knowledge, particularly in the covered areas, to assist in the discovery of the next generation of world-class mines in the region.

- The rich mineral endowment of the North-west Queensland Mineral Province is largely a function of its long and episodic history of basin formation, its structural complexity, and the repeated crust-mantle interaction that produced metal-rich magmas susceptible to fractionation. The key outcome of this study, and the underpinning of the targeting, is the production of an internally consistent four-dimensional geological framework that integrates all of these influences on deposit formation and localisation. Presentation in an accessible, updateable and interactive digital GIS is then fundamental to the accessibility and utility of the study results.

- **Silver-lead-zinc potential and targets**. A comprehensive new structural and tectonostratigraphic framework has been produced for the ~1700–1600Ma basin system that contains the world-class silver-lead-zinc deposits (for example, Mount Isa-Hilton- George Fisher, Century, Lady Loretta, Cannington) of the region. The sequence stratigraphic approach recently applied to the western part of the region by AGSO's NABRE project has been extended to the whole region and used, in combination with a dynamic structural framework and distinctive geophysical signatures, to define new target zones for these deposits.

- **Mount Isa-style copper potential and targets**. The Mount Isa copper deposit is an enigmatic, but particularly attractive target (255Mt at 3.3%Cu). Smaller examples (for example, Mount Gordon, Mount Cuthbert) are also of interest to small to medium companies, especially as solvent extraction/ electrowinning (SX-EW) propositions. The structural, stratigraphic and lithological framework in this product provides new targeting criteria and targets for this deposit type.

- **Iron-oxide copper-gold potential and targets**. Despite the long history of copper mining in the eastern part of the North-west Queensland Mineral Province, the discovery of the Osborne, Selwyn and Ernest Henry mines over the last 20 years has only recently highlighted the province's capacity to deliver world-class deposits of this very attractive style. The common association of magnetite with these deposits led to an initial rush to drill high intensity magnetic anomalies. However, as detailed in this study, it has proved necessary to take a more comprehensive approach to targeting based on multiple geological, geophysical and geochemical/alteration criteria. This study has focused on the recognition of complexly structured and altered roof zones of the ~1500Ma Williams granitoids suite from multiple geophysical and geological criteria to generate numerous target zones for this deposit type.

- **Potential for other deposit types**. Numerous other deposit styles are present in the North-west Queensland Mineral Province, some of which provide attractive targets for both small and large mining companies (for example, Tick Hill high-grade gold, Cambrian phosphate, potentially diamond-bearing kimberlitic intrusions).

GLOBAL PERSPECTIVE

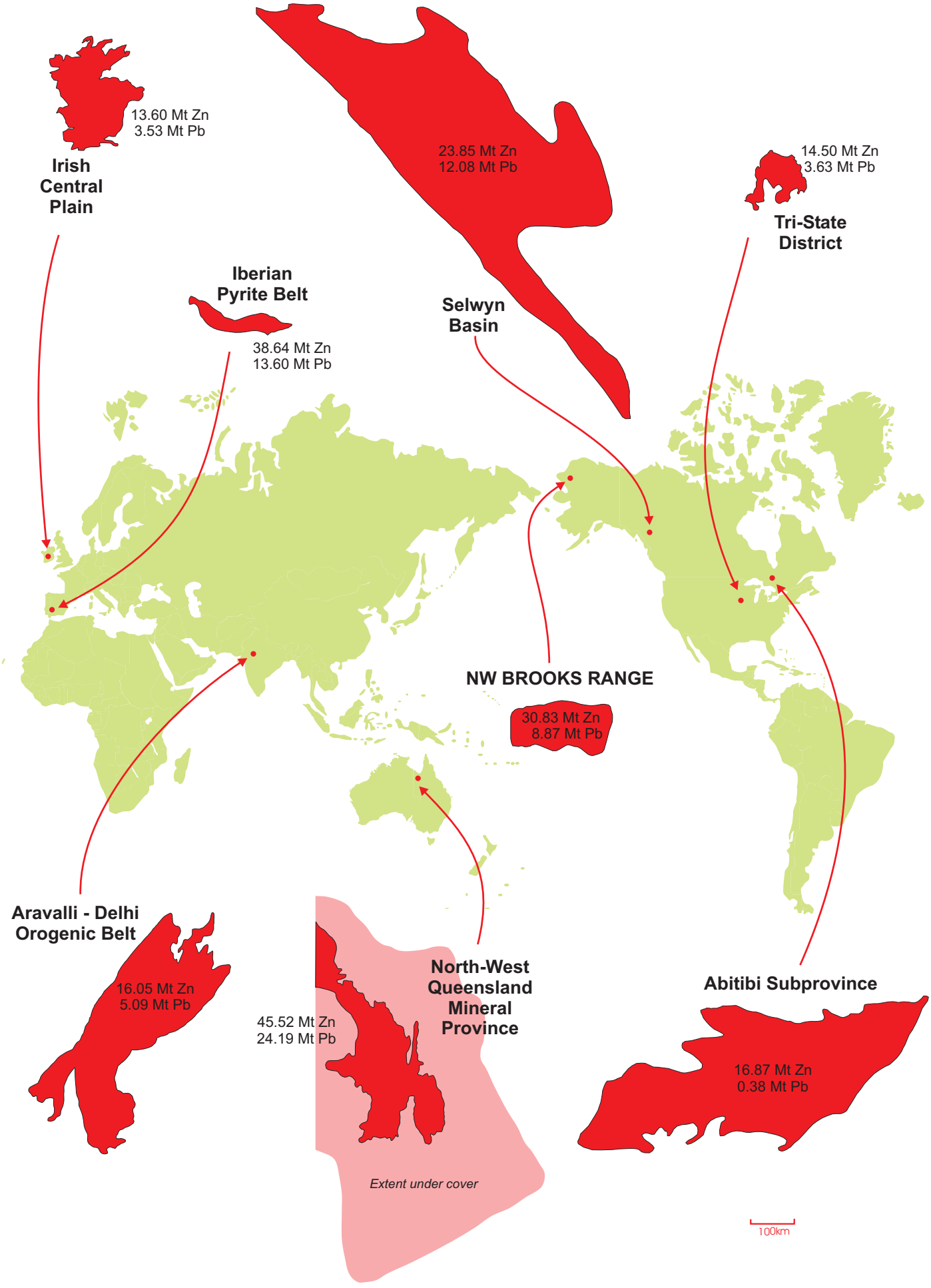
MINERAL ENDOWMENT

Zinc

The North-west Queensland Mineral Province can be regarded as the premier zinc region in the world based on the following information.

Number and Tenor of World Class Zinc Deposits

World class zinc deposits are defined by Singer (1995) as those in the upper 10% in terms of zinc metal content,



Comparison of size and Zn-Pb content of the world's major zinc-lead provinces

Table 1: Comparison of overall Lead and Zinc Contents in major mineralised provinces world wide

PROVINCE	COMPOSITION OF TOTAL	Mt Pb	Mt Zn	Source of Data
NORTH-WEST QUEENSLAND MINERAL PROVINCE Australia	The six largest known deposits	24.19	45.52	
BROOKS RANGE Alaska	Red Dog, Anarraaq and Lik-Su	8.87	30.83	References to each deposit
SELWYN BASIN Canada	The eleven largest known deposits	12.08	23.85	References to the individual deposits
ABITIBI Canada	All known economic resources in the district	0.38	16.87	Barrie & others (1993)
TRI-STATE DISTRICT USA	All known economic resources in the district	3.63	14.50	Kyle (1994)
ARAVALLI-DELHI BELT North-west India	The ten largest known deposits	5.09	16.05	Deb & others (1989)
IBERIAN PYRITE BELT Spain and Portugal	85 deposits, the majority of which are subeconomic	13.60	38.64	Leistel & others (1998)
IRISH CENTRAL PLAIN Republic of Ireland	19 deposits, 14 of which are subeconomic	3.53	13.60	Johnston (1999)

containing a minimum of 1.7Mt zinc. Of the 57 deposits outside the CIS countries and China that meet this criterion, by far the largest concentration (six) occurs within the North-West Queensland Mineral Province, namely, Hilton-George Fisher, Century, Mount Isa, Dugald River, Cannington and Lady Loretta. Of these deposits, four are ranked among the top eighteen in the world in terms of contained zinc in economic reserves, namely, Hilton-George Fisher (3rd), Century (6th), Mount Isa (10th) and Dugald River (18th).

Total Zinc Endowment

The North-west Queensland Mineral Province is the largest known repository of economically mineable zinc in the world. An indication of its global supremacy can be gauged from Table 1, which compares the total contained zinc in economic reserves of the six largest deposits in the North-west Queensland Mineral Province (Hilton/George Fisher, Century, Mount Isa, Dugald River, Cannington and Lady Loretta) with various combinations of total zinc endowment for the largest zinc provinces world wide. The pre-eminence of the North-west Queensland Mineral Province is illustrated by the fact that the total zinc content of these six deposits alone is:

- 2.7 times higher than the total of the Abitibi Subprovince (Noranda, Matagami, Chibougamau areas, etcetera) of Quebec/Ontario in Canada, which has the largest zinc content of all the volcanogenic massive sulphide districts in the world,
- 3.3 times higher than the total zinc content of the 19 largest known carbonate-hosted zinc deposits in the Irish Central Plain,
- 3.1 times higher than the total contained zinc in the numerous deposits of the Tri-State District, which has the largest zinc content of all the North American Mississippi Valley districts,
- 1.9 times higher than the total zinc content of the 11 largest sediment-hosted deposits of the Selwyn Basin in Yukon/British Columbia, Canada, and
- 1.2 times higher than the total of 85 deposits in the Iberian Pyrite Belt, which is regarded as the largest concentration of massive sulphide mineralisation in the world.

Lead

Of the 31 deposits outside the CIS countries and China that meet the Singer (1995) definition of world class lead deposits (> 1Mt Pb), four are in the North-west Queensland Mineral Province. These four rank among the 18 largest lead deposits in the world – Hilton/George Fisher (3rd), Mount Isa (5th), Cannington (7th) and Century (18th).

Silver

The bulk of the world's silver production has come from high-grade vein deposits in Bolivia, Mexico and Peru, from high temperature carbonate-hosted lead-zinc deposits in Mexico and Peru, and as a by-product of lead-zinc mining. In the latter category, the four largest known deposits (production + current reserves) are Broken Hill (1016Moz silver) in New South Wales, followed by three deposits in the North-west Queensland Mineral Province — Cannington (757Moz), Mount Isa (643Moz) and Hilton/George Fisher (517Moz).

An indication of the significance of these deposits in a world context can be gauged from Table 8.4 (in the report), which lists the estimated silver content (production + reserves) of the world's largest silver districts/deposits.

Copper

In terms of total copper mineral endowment, the North-west Queensland Mineral Province is not in the same league as the major porphyry and sediment-hosted copper belts of the

world. Nevertheless, the two largest deposits in the region, Mount Isa (255Mt at 3.3% Cu) and Ernest Henry (127Mt at 1.1% Cu and 0.55g/t Au) represent attractive exploration targets by world standards by virtue of their high in-ground value per tonne.

The Mount Isa deposit, best known as a world class zinc body, is also of world class stature in copper according to the Singer (1995) definition that world class deposits contain >2Mt copper.

MINERAL PRODUCTION

Zinc

The North-west Queensland Mineral Province is a leading source of the world's zinc. Total mine production in the year to end June 2000 amounted to some 296 000t Zn, which is equivalent to 5% of the total western world output in calendar year 1999, or 3.8% of the global total over the same period.

With an output of 106 734t Zn in the nine month period from the inception of production in September 1999 to end June 2000, the Century mine was the region's largest producer in the 1999/2000 year. At its current production rate of some 250,000tpa Zn, Century is the second largest individual zinc producer in the world behind Red Dog in Alaska (~530 000tpa Zn). When it attains its full capacity of 500 000tpa Zn by the end of 2001, Century will provide around 7.4% of the western world's mine zinc production.

At the district scale, the North-west Queensland Mineral Province will become the foremost world zinc producer by 2002 when both Century and the new George Fisher mine (~170 000tpa Zn) are in full production. At that time, the North-west Queensland Mineral Province will yield around 10.9% of the projected western world zinc output.

Lead

The North-west Queensland Mineral Province contains the two largest lead producers in the world — Cannington (~155 000tpa) and Mount Isa/Hilton (~137 000tpa). Together, their production in the year to end June 2000 was equivalent to almost 13% of the western world lead output in calendar 1999, or 9.7% of the global total over the same period.

Silver

In terms of annual production Cannington (~22.5Moz per annum) is currently the world's largest silver producer, yielding an amount equivalent to 4.7% of total western world silver production in calendar 1999. Mount Isa/Hilton (~10.6Moz per annum) is currently ranked fifth among individual mine silver producers after Fresnillo in Mexico (~21Moz/yr), Eskay Creek in British Columbia (~11.7Moz/yr) and McCoy/Cove in Nevada (11Moz/yr).

Copper

With an output of 335 000t in the 1999/2000 year, the North-west Queensland Mineral Province provided almost half of Australia's total mine production of copper. In a world context, the North-west Queensland Mineral Province output is small compared with the top producers — Chile (4.38Mt in calendar 1999) and USA (1.63Mt) — but is nevertheless significant when compared with the likes of Peru (536 000t), Mexico (381 000t), and Zambia (340 000t), three major copper-producing countries.

DISCOVERY RECORD

Table 8.6 (in the Report) lists significant zinc and copper discoveries world wide (outside the CIS countries and China) over the past 20 years. In that period, the North-west Queensland Mineral Province can claim to have the best greenfields zinc discovery rate of any mineralised province in the world in terms of the number and size of the discoveries (Century, Cannington, Walford Creek, Grevillea). Century is the second largest zinc discovery of the past two decades behind Red Dog and, although Cannington is primarily a lead-silver deposit, its zinc content is such that it is eighth largest in the ranking of zinc discoveries since 1980.

In terms of total greenfields zinc metal discovered since 1980, the North-west Queensland Mineral Province is the second ranked region in the world behind the Brooks Range of Alaska, where the various components of the Red Dog deposit now amount to 26.7Mt and the Anarraaq discovery in 1999 added a further 2.16Mt.

In addition to the new discoveries, there have also been significant additions to the total zinc resource endowment of the North-west Queensland Mineral Province over the past decade through further drilling of the Dugald River, Lady Loretta and Hilton/George Fisher deposits, all of which were discovered prior to 1980.

Regarding copper, there have been no discoveries in the North-west Queensland Mineral Province to match the size of those in the porphyry belts of Chile and Indonesia, but the region nevertheless boasts a good discovery record for medium-sized copper-gold deposits. Since 1980, three such deposits have been found and put into production — Selwyn (7.4Mt at 1.9% Cu and 3.8g/t Au), Eloise (3.1Mt at 5.5% Cu and 1.4g/t Au) and Ernest Henry (127Mt at 1.1% Cu and 0.55g/t Au).

As for gold, there are no known major deposits of world class stature in the region, but the 1989 discovery of the small, high-grade Tick Hill deposit proved to be a lucrative find for Mount Isa Mines Ltd. In the 1992 to 1995 period, the deposit yielded a total of 511 000oz Au from 706 000t of ore for an average grade of 22.5g/t Au.

GEOLOGY

TECTONIC FRAMEWORK

The Proterozoic of the North-west Queensland Mineral Province is summarised in Table 2 as follows:

- nature, architecture, kinematics and initiation age of the major structural elements,
- tectonic settings in which these elements are interpreted to have initiated,
- reactivation events, their kinematics and resulting architectures,
- significance of these tectonostratigraphic elements and histories in the development of lithological packages hosting base metal and gold deposits and related hydrothermal plumbing systems, and

Table 2: Part of Tectonic Events table from North-West Queensland Mineral Report

Fault Code	Initiating Event / Age	Tectonic Setting	Fault Components / Orientations	Reactivation History	Controls on Mineralisation	Continental Correlations	
AR	Possibly inherited from Late Archaean basement ~2500Ma	Possible suture between Late Archaean to Early Proterozoic craton to the west and another, possibly more primitive terrane to the east, reactivated during the Barramundi Orogeny	Major contributor to the overall N-S structural grain of the Mt Isa Inlier	Repeatedly reactivated during all subsequent events. Localized Leichhardt River Fault Trough (LRFT) as pull-apart basin on Cover Sequence 2 (CS2) transfer step-over. Acted as major sidewall localizing Wonga extension.	No mineralisation during initiation, but had major influence on localization of all major deposit styles at regional to local scales during repeated reactivation history.		
BA seq	Barramundi basin formation ~1900Ma	Poorly constrained, possibly ENE-WSW extensional accommodation structures and NW-SE normal faults.	Broad (10-20km), poorly defined zones of ENE-trending fracture and pattern break. Some short, low displacement faults / fractures seen in magnetics	No major reactivation, but produced pattern breaks and jogs in most subsequent structures	No direct controls on mineralisation, but indirect influence by localizing jogs / complexity of younger structures	Consistent with interpreted transfer structures of Barramundi Sequence age in Pine Creek & Granites-Tanami	
BA	Barramundi Orogeny → major compressional structures (and possible sutures). ~1870Ma	Poorly constrained, but probably ENE-WSW shortening reactivating AR structures as broad, east-dipping, crustal scale reverse fault zones. Possible Barramundi-reactivated suture between Late Archaean to Early Proterozoic craton to the west and another, possibly more primitive terrane to the east.	NW to N-trending, major gravity and magnetic boundaries; also define boundaries of major Barramundi basement blocks and Cover Sequence 2 (CS2), Wonga and Cover Sequence 3 (CS3) rift / basin edges.	NNW-trending segments in south of region reactivated as major, controlling strike-slip / sidewall zones during 1675Ma (CS3) transtension. Reactivated as reverse faults during ~1710Ma compression event & Isan Orogeny (D2).	No mineralisation during initiation, but had major influence on localization of all major deposit styles at regional to local scales during repeated reactivation history. Influenced patterns of faulting, rifting, subsidence, sedimentation and magmatic activity during Wonga (Tick Hill-style Au), CS3 (Isa-Century and Broken Hill-Cannington-style Zn-Pb-Ag) and Isan Orogeny (Fe-oxide Cu-Au)	~E-W compression is dominant Barramundi deformation event kinematics in Pine Creek and Arnhem Land. Weaker to absent in Davenport, Tennant Creek and Granites-Tanami provinces.	

- the broader (continental) context of the major tectonostratigraphic elements and events.

This structural and tectonic framework is presented as a series of structural event maps or layers in the digital product. These maps and Table 2 provide a dynamic view of the structural evolution of the North-west Queensland Mineral Province, linking the tectonic and structural history of the principal mineralising episodes.

The structural event maps document the distribution and evolution of key structures interpreted to form essential elements of the hydrothermal plumbing systems responsible for base metal and gold in the northern Australian Proterozoic. As such, the event maps/layers are of special value in the targeting of these systems in the North-west Queensland Mineral Province (see Report Chapters 6.2 and 11.3).

PROTEROZOIC SOLID GEOLOGY AND STRUCTURE

Construction of the 1:250 000 Proterozoic geology was by far the largest component of the study. It was considered to be an essential basis for systematic and reliable targeting and, most importantly, it enables the user to thoroughly evaluate the targeting criteria and target choices by providing a transparent and systematic basis for those choices. Because of the extensive mapping, research and exploration history in the region, the value added by this product is incremental in the outcropping areas, but is substantial in the covered areas where much of the discovery potential lies.

The following outcomes are considered to be the most significant, and to be of particular interest and potential value to the exploration industry:

- **The 1:250 000 Proterozoic geology is the first contiguous, four-dimensional solid geology interpretation of the outcropping and covered areas of this world-class mineral province**. It correlates stratigraphic sequences, unconformities, structural/tectonic events, igneous episodes and mineralising events and processes across a region of more than 290 000km^2. In particular, it provides the fundamental geological backdrop to reducing the inherent risk of targeting and exploring in the extensive and highly prospective covered parts of the Proterozoic.

- It extends the excellent work of AGSO's NABRE project (Southgate & others, 2000) in aggregating and correlating a complex and somewhat confusing lithostratigraphic framework and nomenclature into **a systematic set of time-stratigraphic sequences across the region, while retaining the essential lithological information**. In combination with the Time-Space Chart and the Tectonic and Structural Framework, it then provides a dynamic picture of the evolution of the North-west Queensland Mineral Province

through a complex history of basin formation and inversion events.

- **It provides the first systematic, specific and detailed geological connection between the western and eastern parts of the province**. This is particularly so for the economically critical post-1700Ma period.

- **In the eastern part of the province, the solid geology provides, for the first time, an internally consistent interpretation of the sequence stratigraphy of the Soldiers Cap Group and correlatives**, which links the previously mapped outcropping areas with the extensive covered areas. Both Cannington and Broken Hill arguably occur at a specific level in the Cover Sequence 3 or equivalent tectonostratigraphy (that is, at or just above the break between syn-rift and post-rift). The map interprets the location of that boundary throughout the covered and outcropping areas, providing a key component for targeting Broken Hill-Cannington style Ag-Pb-Zn deposits.

- **In the western part of the province, a newly rationalized understanding of the tectonostratigraphic architectures and inversion architectures of the sequences that underlie the Isa Superbasin provide a tighter framework for targeting in the Isa Superbasin (Cover Sequence 3) sequences**. In particular, rock relationships (in part mapped in the 1:100 000 Geology map series) have been highlighted to emphasise the importance of a new transpressive constrictional event around 1710Ma which, coupled with the preceding 'Wonga'-aged extensional block tilting, both defines compartments and creates topography, which is filled by the sequences regarded as critical aquifer facies for later base metal mineralisation. This transpressive constrictional event at Big Supersequence times, which has been mapped and interpreted throughout the Western Succession in the current study, is consistent with previous observations below the Surprise Creek unconformity in the Paroo Range area by Nijman & others (1992), and relationships in the Mellish Park Syncline of Betts (1999), but conflicts with suggestions by O'Dea & others (1997).

- In addition, in the western part of the province, an improved understanding of both the geometry and kinematics of structures active during Isa Superbasin deposition, in particular those at 1640Ma, has defined sidewall- accommodation and normal fault compartmentalisation of these sequences. These architectural elements are among the fundamental geometric controls on (1) the facies distribution of base metal host sequences, and (2) the synchronous or subsequent fluid flow focus that formed base metal deposits within the Isa Superbasin.

- **Virtually every mapped structure is attributed with its age, geometry and kinematics at initiation and throughout its reactivation history**. Therefore, the structural evolution of the area can be extracted and analysed, and cross-sections constructed that reflect the three-dimensional geometry and movements event by event. In this way, structural interactions and kinematics that may have influenced localisation of fluid flow and mineralisation can be extracted from the product. The structural complexity of the area, with grossly different kinematics during each of the significant events, means that it is very difficult to construct meaningful and accurate cross-sections. For this reason, a conscious decision was made in the study not to include regional cross-sections. However, users of this report should be able to construct local cross-sections that illustrate particular details of one or more structural events from the maps and digital data.

- **The solid geology includes interpretation from the geophysical data of buried felsic intrusives**. In the covered areas, this refers to intrusives that do not subcrop the base-Phanerozoic unconformity. Since a key targeting criterion for Cu-Au deposits is the roof zone of felsic intrusives of a particular suite/age, this information is of significant value to exploration and has been incorporated into target definition in this product.

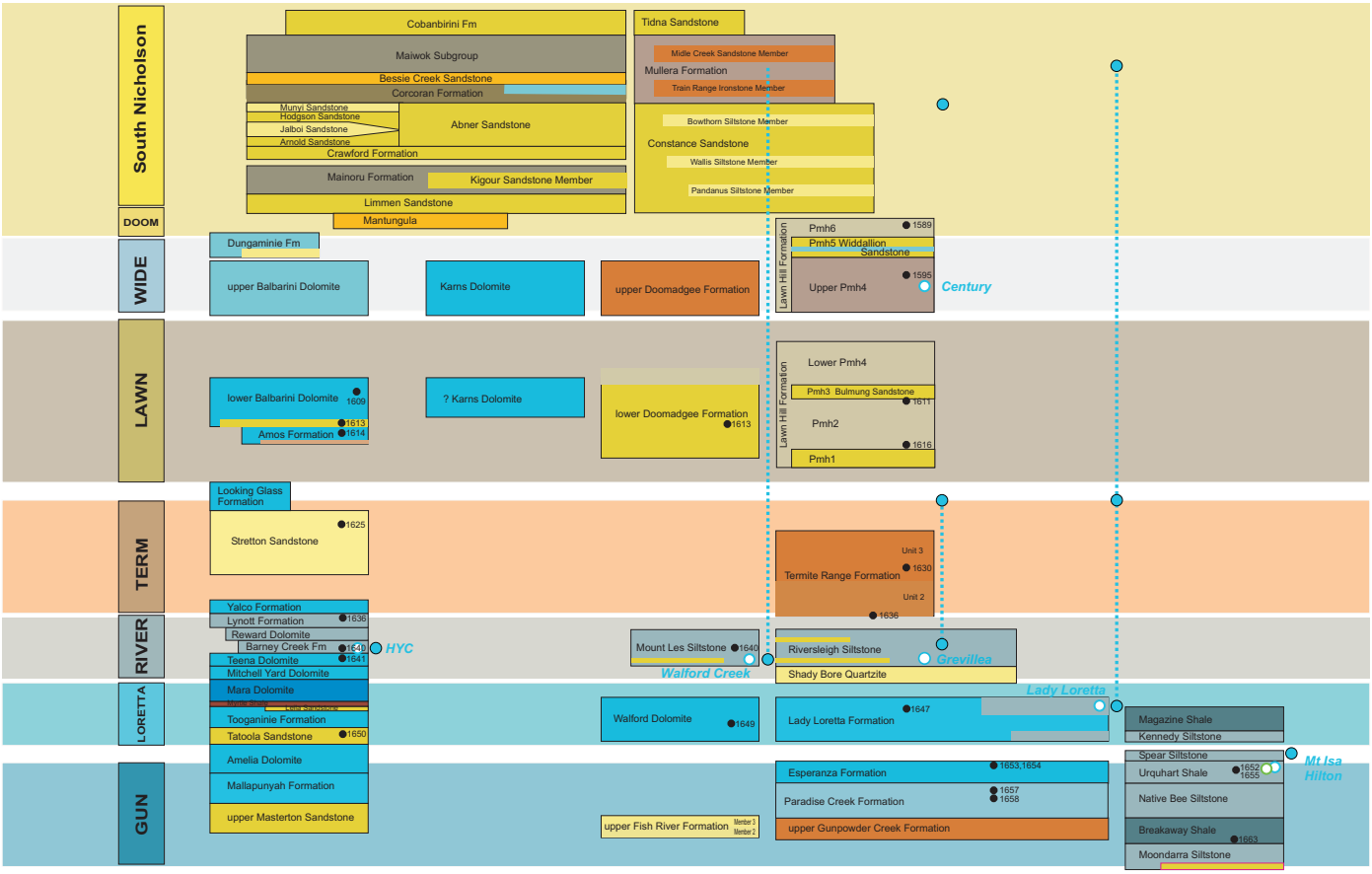
TIME-SPACE MATRIX

The Proterozoic Time Space 'Event Stratigraphy' chart is a state-of-the-art compilation of all tectono-stratigraphic relationships and sequence correlations in the North-west Queensland Mineral Province, placed within a tectonic, 'event stratigraphic' framework for the period 1900Ma–1500Ma. It highlights the obvious (to quite obscure) basin phases and the significant tectonic events that separate them. The generally familiar and, more importantly, accurately mapped (at 1:100 000 and 1:250 000 scale), lithostratigraphic units are cast within the NABRE sequence stratigraphic framework for the period 1700Ma–1590Ma (Southgate & others, 2000). For sequences outside this period, more traditional sequence terminology from the literature is used.

The chart includes, for comparison, relationships within adjacent, tectonically-linked terrains: to the west, the Tennant Creek-Davenport Provinces; to the north, the Southern McArthur Province; and to the east, the Georgetown Province. It incorporates, as far as possible, all recent (published and unpublished) geochronology, Australian Polar Wander Path (APWP) correlation and fluid overprint information, NABRE sequence stratigraphic relationships, as well as speculations of the Northern Territory Geological Survey and the current study's authors about sequence correlations. All detailed correlation relationships and the broad geometries and kinematics of tectonic events active during sequence accumulation, inversion and deformation are explicitly presented on the chart.

Key datasets and data sources incorporated into the Event Stratigraphy chart are:

- **NABRE Sequence Stratigraphy** Numerous discussions with Peter Southgate, Deb Scott and other NABRE team members have greatly helped in the assimilation of the vast volumes of detailed sequence relationships presented in the NABRE studies. These have largely been replicated on the chart within the Western Succession for the period 1700Ma–1590Ma. Key reference sources include: Australian Journal of Earth Sciences, volume 47(3), June,



Portion of Proterozoic Time-Space 'Event Stratigraphy' chart

2000; AGSO Records 1999/10, 1999/15, 1999/19, 1999/27; Scott & others (1998).

- **Australian Polar Wander Path (APWP) Palaeomagnetics**

The Proterozoic APWP for Northern Australia is very well defined for the interval 1740Ma–1640Ma, whereas the succeeding 1640–1500Ma period is understood in broad terms only. It is characterised by a series of Inflection points ('hairpins' and 'cusps', for example, I1650, I1710…). Because the Australian Proterozoic APWP represents the 'drift' of the entire Proterozoic continent, these inflections represent significant **inter**-plate (outside or marginal to the plate) interactions that can reasonably be assumed to result in significant **intra**-plate (within the plate) deformation or tectonic re-adjustment (Loutit & others, 1994). These events have been highlighted on the chart and are expressed either as: (a) sequence stratigraphic events within accumulating sequences, (b) inversions or moderate deformation of basin successions, or (c) major orogenies of regions or entire terrains.

Major palaeomagnetic resetting or overprinting episodes (for example, OP1, OP2…), coincident with some APWP Inflection events, suggest major fluid flux events that have also been implicated in particular base metal mineralisation episodes. Stimulating discussions with Mart Idnurm have sharpened our understanding of the Proterozoic APWP, in particular the indirect and non-intuitive relationships between APWP Inflections and tectonic geometries and kinematics. Key references are: Idnurm & Giddings (1988); Idnurm & others (1995); Idnurm (2000); Loutit & others (1994).

- **Geochronology**

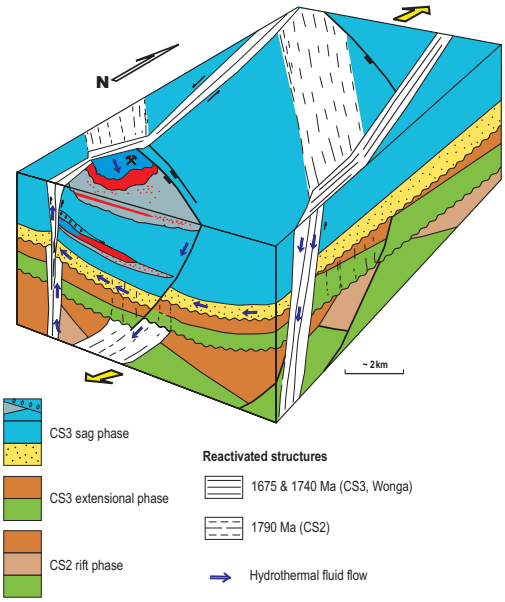
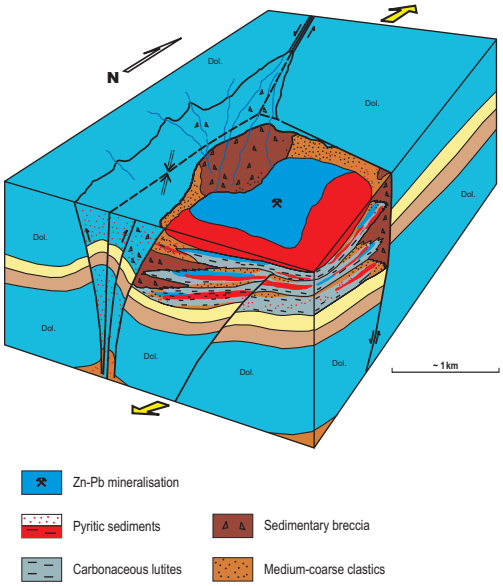
AGSO's OZCHRON (release 2) has provided a comprehensive compilation of published geochronology that has been directly incorporated into the Event Stratigraphic chart. Further details (for example, error bars, sample site, analysis technique) for geochronologic information on the chart can largely be found in OZCHRON.

Some more recent geochronology, possibly not yet incorporated into OZCHRON, can be found in NABRE publications. Direct discussions with Rod Page have clarified the significance of some of the geochronology. Isotopic dating of the Eastern Succession Cu-Au mineralisation and associated metasomatism have come direct from the literature. Key resources in the construction of the chart have been: AGSO's OZCHRON (release 2) database; Page & Laing (1992); Page & Sweet (1998); Page & Sun (1998); Page & others (2000); Perkins & Wyborn (1998).

- **Lead Isotope Model Ages**

Model ages for the formation of the Zn-Pb-Ag deposits have come exclusively from the works of Graham Carr (CSIRO) and Shen-Su Sun (ex AGSO). Numerous discussions with them have clarified the mixing options in the more complex lead systems in some of the region's base metal deposits which have been presented on the chart. Key references include Sun & others (1994) and Sun & others (1996).

TARGET MODELS

STRATABOUND Zn-Pb-Ag: ISA-CENTURY-STYLES	TARGET CRITERIA
REGIONAL TECTONOSTRATIGRAPHIC MODEL  **STRUCTURAL AND LITHOSTRATIGRAPHIC LOCALISATION** 	Mineralisation: Supersequences and event(s) Tectonostratigraphic domains Regional structural settings Local structural settings Host lithostratigraphic settings
ESSENTIAL ELEMENTS ▪ Brine, high SO_4^{2-} / H_2S, 100-200°C - evaporite source - acid fluid (? clay-carbonate buffer) ▪ Fault system – related fluid circulation system connecting - fluid recharge zone - faulted basement and basal sandstone aquifer - fluid discharge fault zone ▪ Ore deposition in infiltration zones - interaction with kerogen, and/or mixing with reduced fluids effecting thermochemical sulphate reduction - host rock carbonate dissolution and acid neutralisation - fluid cooling	Mineralisation indicators

MINERALISATION MODELS

The North-west Queensland Mineral Province exhibits a broad range of deposit styles containing a wide range of metallic and non-metallic commodities.

Within commodity classes (groups of commodities occurring naturally, for example Ag-Pb-Zn), several styles of mineralisation are recognised based on the:

- form of the deposit or occurrence,
- mineralogy of the occurrence and apparently related alteration, and
- character of the host rocks.

Descriptions of, and exploration targeting criteria for, key styles of mineralising systems are given in the **Target Styles**: Chapter 6.2 section of this report.

Limited information on some mineral occurrences in the North-west Queensland Mineral Province has rendered uncertain their classification into appropriate mineralisation styles.

Mineralisation styles in the North-west Queensland Mineral Province are further related to one or more tectonostratigraphic events, as described in the time-space framework, based on:

- absolute isotopic dating of mineralisation, associated alteration or contemporaneous host rocks, in a few cases,
- relative timing, utilising observations on geometric, thermal or geophysical overprinting or cross cutting relationships, and
- analogies with chronologically well-established examples elsewhere.

Where temporal relationships are poorly understood or otherwise uncertain, mineralisation styles are assigned to broad or unknown tectonostratigraphic age groupings.

Information from the Queensland Department of Mines and Energy mineral occurrence (MINOCC) database, AGSO's MINLOC database and other sources from the literature have been utilised to classify over 3000 mineral occurrences in the North-west Queensland Mineral Province in terms of style, timing and relative size. To clarify their spatial distribution and relationships to geological domains and key structures, these data are plotted in Map 3 (in the Report)and may be overlain on a broad range of lithological, stratigraphic, structural and geophysical layers, for example Maps 5, 6, 7 (in the Report).

In relation to the distribution of mineralisation in the Proterozoic:

- Stratabound Zn-Pb-Ag deposits occur in several geological domains in sediment- dominated Cover Sequence 3 blocks, but Broken Hill-Cannington styles are restricted to medium and

high grade metamorphic rocks of the Eastern Fold Belt.

- Vein and breccia Ag-Pb-Zn occurrences are more broadly distributed than stratabound deposits, but tend to cluster around the same fault systems as the latter deposits.

- Copper occurrences are broadly distributed in the North-west Queensland Mineral Province but are most common in the western half of the belt. Isa-style copper mineralisation occurs mainly in greenschist facies metasedimentary hosts of Cover Sequence 3. Other vein-breccia styles are distributed through a range of lithologies and host rock ages, from subgreenschist to lower amphibolite facies metamorphic grades. However, most styles of copper mineralisation are spatially related to fault systems active/reactivated during D2 and D3 deformation.

- Copper-gold deposits occur mainly in amphibolite facies hosts in the eastern half of the North-west Queensland Mineral Province, in the Wonga and Eastern Fold Belt domains. In these domains, the copper-gold occurrences are mainly spatially associated with felsic plutons (they cluster around the roof zones of Williams, Naraku and some Wonga granites) and magnetically anomalous zones, as well as temporally associated with fault systems active/reactivated during Wonga extension (1740Ma) or post-D2 deformation (in the case of the Eastern Fold Belt domain).

- Gold-dominated deposits are relatively sparsely distributed in medium-grade metamorphic hosts, mainly in the Wonga and Eastern Fold Belt domains. In the former, gold occurrences appear to be spatially associated with Wonga age (circa 1740Ma) plutons, and localised around fault systems that were deformed (folded, reactivated) during regional deformation. Gold occurrences in the Eastern Fold Belt domain, however, are spatially associated with fault systems active/reactivated post-D2 and Williams age (circa 1500Ma) plutons and related alteration. Auriferous systems coeval with Wonga and Williams granites overlap with the more widespread copper-gold systems.

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Veritas Gold - an online window to Australian exploration data

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Any digital file can be archived with a related data feature. For example a seismic line or survey could include scanned observer's logs, seismic sections, acquisition and processing reports, navigation data, or SEGY files. Similarly well completion reports, digital well data and scanned logs could be archived in association with a well. ***GOLD*** then enables the user to view or download any of these archived files to their desktop via the internet.

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VERITAS GOLD™ is ideal for data vendors looking for a more effective method to promote and sell data to Exploration Companies. As such Veritas have established a view (OZ GOLD), containing exploration data from several of Australia's leading data providers. The OZGOLD view also includes useful permit and cultural information.

The Explorationist can use the OZGOLD View to quickly establish what data is available in their area of interest and proceed with preliminary investigations into the quality of the data , before deciding whether to purchase. This greatly simplifies their search for data and also provides them with the ability to interactively query and view the data. For the Vendor ***GOLD*** is a significantly cheaper form of advertising compared to more traditional advertising methods, but with the added benefit that the content always remains current and can readily be updated.

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Web Delivery Systems-Government

DIGS an Information delivery vehicle on the Web

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The Digital Imaging Geological System (DIGS) project began in 1995 and involved the capture of the record holding industry and government geological and mineral exploration data held by the NSW Department of Mineral Resources (DMR). The entire open file collection has been available on the Internet since February 2000.

Due to the nature of the geoscience digital information (image and other digital data), DIGS on the Internet has been designed as an “information delivery vehicle” where users identify particular documents via an electronic document list or by viewing a reduced resolution image. Users are then able to deliver the document by down loading via their web browser or by sending the material via e-mail or order a print out of the particular document.

A new feature will be the integration of DIGS tools allowing a spatial query to link located objects (titles, drill sites, surveys) with a document (images or digital data). Delivery of geoscience Information on the Internet has the ability of attracting new clients through increased access on a global scale.

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DIGS an Information delivery vehicle on the Web

Introduction

The project's key objective is to preserve the items in the geological survey report collection, by creating a digital copy of the collection. This unique collection is classified as a State Archive. By using an efficient and innovative delivery system the collection is available to clients via an Internet browser screen. The DIGS® project is seen as a catalyst in achieving Department of Mineral Resource's vision of improved effectiveness and customer service and playing a part in attracting exploration expenditure to NSW.

The Discovery 2000 DIGS (Digital Imaging of Geological System) project began in 1995 and has completed the program of capturing the entire record of industry and government geological and mineral exploration data held by the New South Wales Department of Mineral Resources (DMR). This unique information asset, comprising published and unpublished exploration, mining and departmental reports, collected over 125 years, is now available in digital form. DIGS has been available to the public at the (DMR) St Leonard's Head Office of the Department of Mineral Resources since March 1996, and at regional offices in Orange, Broken Hill, Armidale and Singleton since June 1998.

At the same time the Minfinder, the DIGS bibliographic database, which contains a listing of all the geological reports in the system and a brief abstract of the contents of the non-confidential reports, has been available on the DMR website since 1997. The Minfinder database, has been gaining in popularity with over 1000 users and averaging 3,000 Kbytes of data down loaded each month. Minfinder is now included within the DIGS system.

The collection of over 35,000 non-confidential reports is now accessible via the Internet on the DMR web site. Black and white, greyscale, or colour images of each report can be examined. Entire reports or selected sections can be ordered through a Reproduction Bureau either in hard copy or in digital form. DIGS on the Internet has been designed as an "information delivery vehicle" where users identify particular document via an electronic contents list or by viewing an image. Users are then able to deliver the document either by down loading via their browser, by sending the material via e-mail or arrange a print of the particular document via a reproduction bureau.

Business Issues and Conceptual Design of DIGS on the Internet

A number of business rules influenced the conceptual design of the application.

1) The solution should be based on open rather than proprietary software, with an emphasis on customising and configuration rather than development. The application was developed to run any standard browser client on any environment that supports HTML and Java.
2) Consideration of a link to the current DIGS environment at head office such that images and associated report metadata can be accessed from DIGS, thus avoiding

duplication of information and infrastructure. The DIGS system resides on an Alpha server and associated “worm jukeboxes” where the digital data or images are stored. The solution required the connection of the Internet server to "question" the databases on the main DIGS alpha server and deliver information as metadata or the reports themselves through the use of computer scripts to access the data.

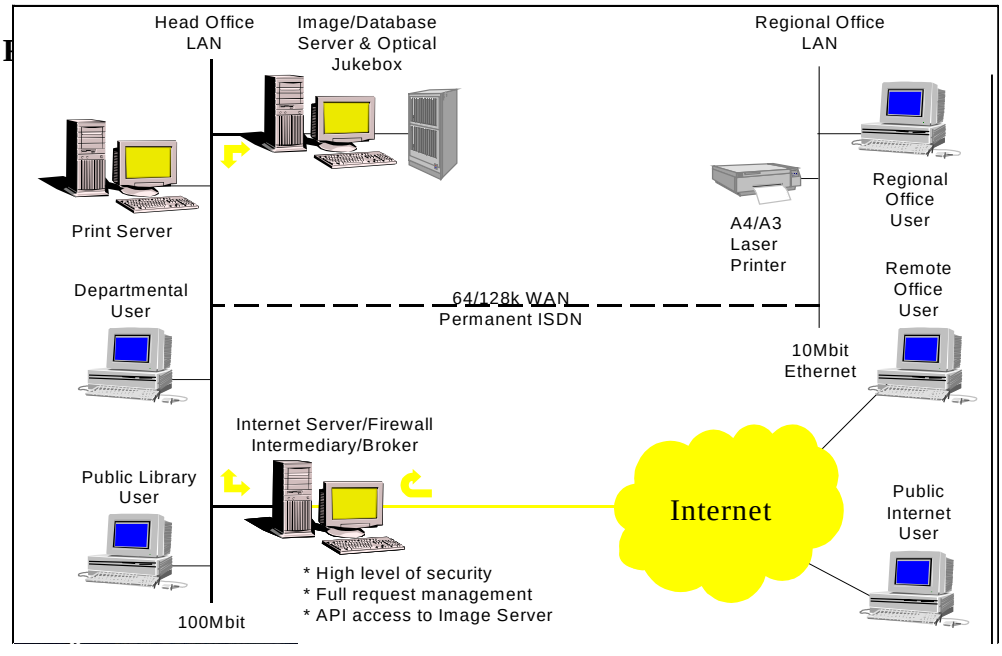
3) An Internet solution that considers both the needs of regional/country office staff and those of clients wishing to gain access to the collection at regional/country offices and via the Internet.
4) Security of the confidential reports is paramount regardless of the final solution in particular physical access to storage media, direct access to the Departments network and access to confidential information.
5) Development of an Internet copy of images, in particular the compression of larger black and white, colour and grey scale images to achieve acceptable Intranet/Internet performance whilst maintaining a reasonable quality for on screen display.
6) Improve the level of service, to that provided by the manual GS report system, with consideration to confidentiality, security, technical and cost constraints.

Design of DIGS on the Internet

Hardware and Software

Prior to development of the Internet version of DIGS a hardware and software infrastructure was already in place, providing access to the Departmental internal and external clients through the use of the wide area network (WAN) at the Department’s head and regional offices. (see Quarterly Note 109) The main storage of the exploration reports uses two HP jukeboxes, which can hold over 1 Tb (terrabyte) of information, connected to an Alpha 2100 server with 256-Mb ram and 10Gb of disk space. To connect DIGS to the Internet, a Firewall server, connected to an Internet server, was linked to the main DIGS server.

The main foundation for the Internet version of DIGS is an application called Netbroker; a product for multi-tiered transaction applications. This software allows for secure access to data from current technology and legacy systems across the Internet. This software “takes simple or complex requests, breaks them down into subtransactions and drives other server machines to produce a response, which is then delivered back to the users browser".



The Netbroker application uses a Java version of the Fulcrum full-text search engine to process requests from users searching the bibliographic database. This bibliographic data is then presented to the authorised user who is able to order copies of images or digital data to be delivered from the main DIGS System in a number of ways. The DIGS system holds metadata consisting of the bibliographic database and the information on particular documents that make up the reports in two main database tables called Minreps and Mindocs. The Minreps table contains information about reports. The Mindocs table contains information on documents such as text, tables maps diagrams that make up the report. (See Brookes et. al., Quarterly Note 109)

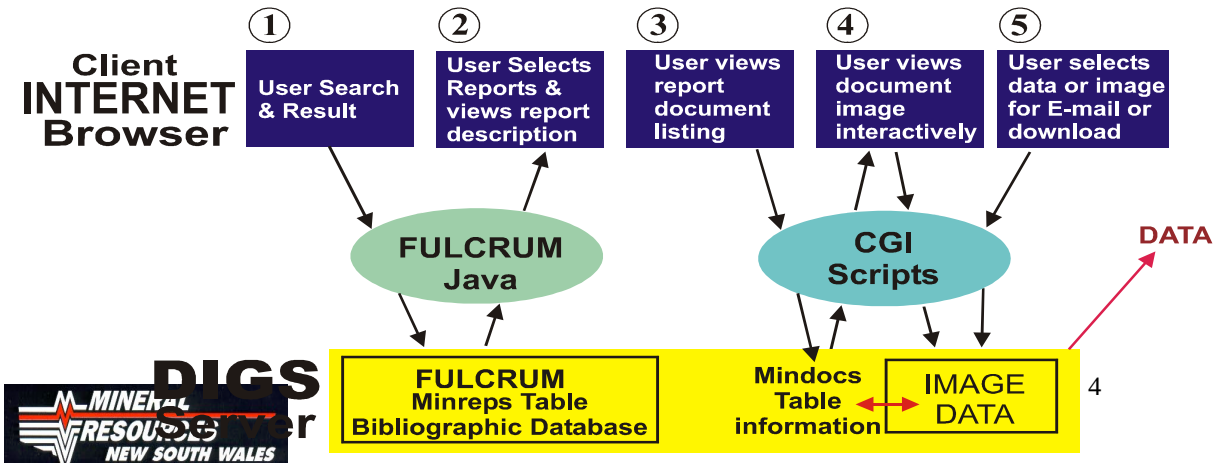
Linking to a current application

The Internet version of DIGS involved the installation of an Internet server and associated "firewall" to prevent unauthorised access to the Departments network. External requests are passed through the "firewall" to the Internet server. Responses to requests are placed on the Internet server and then delivered out to the clients.

Software used on the delivery application included the Netbroker application. It fills two roles; firstly linking to an accounting database designed to hold all information relating to an account eg account details, lists, users. Secondly as a control database holding information relating to the site eg functions, menus, groups, site details. Incorporated to these Internet management functions are Java scripts which control the searching of the bibliographic database and associated with CGI scripts that allow delivery of actual report images or data.

An initial request allows the user to log onto the Internet Server. Once a user logs onto the system a search is conducted on a Java version of Fulcrum on the Internet server. This search is then sent via an SQL (Standard Query Language) inquiry to the main DIGS server, where the search is conducted and bibliographic information is returned to the Internet server. It is compiled into a HTML page for delivery to the user's browser. If a user then selects an individual report for further investigation the full bibliographic listing is sent to the browser. The user may then select the list of documents comprising the report (eg contents page, summary, text pages, appendix, maps, plans). A CGI script returns the list of documents and a html page is again created and sent to the browser. A user then can the select a document for interactive viewing, downloading or to be sent via e-mail.

Figure 2 Flow diagram showing interaction of clients to DIGS on the Internet



The CGI Scripts which allow delivery of report and digital data integrate with the DIGS main server to provide three functions; firstly document information, secondly loading up the image document conversion filter and thirdly locating an image or digital document.

Functions of CGI SCRIPTS

1) **Document Information:** Get a document script, which locates the details about a particular document from the mindocs database. The script returns a html document with two frames and provides information from the mindocs database about a document in particular number of pages, colour (or black and white), original paper size and a description of the document.

2) **Document Conversion:** Filter: Filter for converting B/W Tiff images to GIF format for Internet viewing. Large format images were required to be scaled down. The scaling rules are based on the number of pixels in the image.

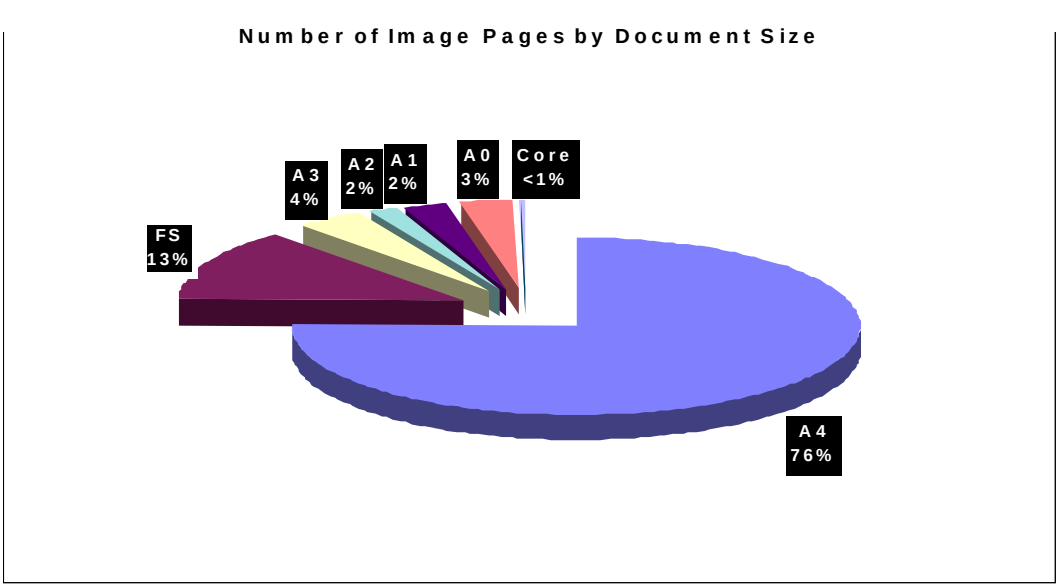
3) **Locating an Image:** Filter for locating images through the use of SQL and return the images to the converted string if required. The script located the image on the jukebox ie finds disk number and images location on disk.

Image Conversion for report access

The DIGS collection consists of around 35,000 reports with images or digital data. The size of the colour and grey scale image files was a major concern. DIGS was developed with two copies of the colour and grey scale images which are called an archive copy and working copy. The archive copy contains the best quality copy of the colour components of the collection with some individual AO colour drawings reaching 480Mbytes in size. To overcome potentially large file sizes, the working copy comprises the entire colour document but at a reduced resolution, eg. AO colour drawings would be reduced to approximately 4 or 5 Mybtes in size. The archive copy is stored off line while the working copy will be stored on near line optical disk jukeboxes capable of storing over 1 Terabyte of data. Black and white images are held in the Tiff format. As shown in the graph below the highest proportion of images are black and white and are small in size being A3, A4 or FS (foolscap) in paper size. An A4 page can vary considerably in file size when converted into image form depending on the number of black and white pixel's but in tiff form it is normally well below 100kb.

An important consideration in the development of the Internet application was for a browser to view GIF and JPEG files without the installation of additional "plug-in" software. Note that the TIFF format is not supported directly by current browser technology.

To deliver a suitable product to the clients it was decided that for "interactive" viewing, clients would receive a reduced resolution "Internet" GIFF or JPEG.



Clients requesting images by e-mail or download via the browser are provided a working quality copy of the image. The colour and grey scale images have been degraded to 150DPI (in some cases 100DPI) with a 75% JPEG factor. Black and white images are at 300DPI to 400DPI TIF G4 format. Digital data such as ASCII or PDF files can only be accessed through the down load or e-mail functions.

Figure 3 Break up of DIGS system based on approximate original paper size

Internet Function	Image format	Image Resolution	Other Formats
Interactive viewing	GIF or JPEG	Internet	Not Available
E-mail	TIF or JPEG	Working copy	complete file
Down Load	TIF or JPEG	Working copy	complete file
Bureau Order	variable	Archive images	complete file

Table 1 Showing image format on the Internet based on delivery mechanism

Image conversion for interactive viewing across the Internet

The working copies of grey scale and colour are currently held at the working copy size of 150dpi and 75% JPEG. To provide for acceptable interactive viewing directly to the browser the images are further reduced. The amount the images are reduced is based on the original paper size of the image. For example for A4 images the working copy image is further reduced by a factor of 50%.

Table 2 Image reduction for "interactive" viewing across the Internet

Reduction factor for colour, grey scale JPEG images

Paper Size	JPEG reduction Factor
A3/A4	50%
A2	62.5%
A1/A0	44.4%

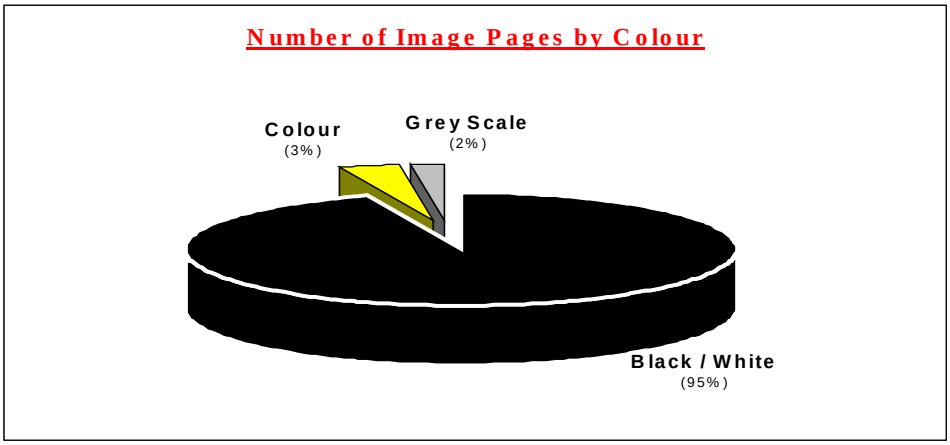
Reduction factor for black and white images

Paper Size	Pixel Reduction Factor	Internet Image Format
A4	80%	GIF

A3	56%	GIF
A2	40%	GIF
A1	28%	GIF
A0	20%	GIF

Black and white images are converted from TIF to GIF on the fly by a CGI script to be read directly by the web browser. The script estimates the pixel size of an image based at 300dpi and then converts the image based on of pixel size. (see table 2)

Figure 4 Proportion of DIGS system images based on document colour, black and white or Grey Scale. The large number of black and white images makes image delivery on the Internet more acceptable.



Access to DIGS

User access to DIGS on the Internet has been provided at two different levels as a "Guest" user or an "Account" user. The purpose of having the two levels is to provide the system with an e-commerce capability and to reduce the load on the actual image system. Guest users can only access textual databases and not the actual report image or digital data.

A "Guest" user is an infrequent user of the system with no account with the Department. They are allowed access to the bibliographic database, which enables the user to search and locate a particular report and view the document list within a report so that a print order can be sent to the reproduction bureau if required. A guest user cannot down load or e-mail images. The guest user pays the reproduction bureau directly for any transactions.

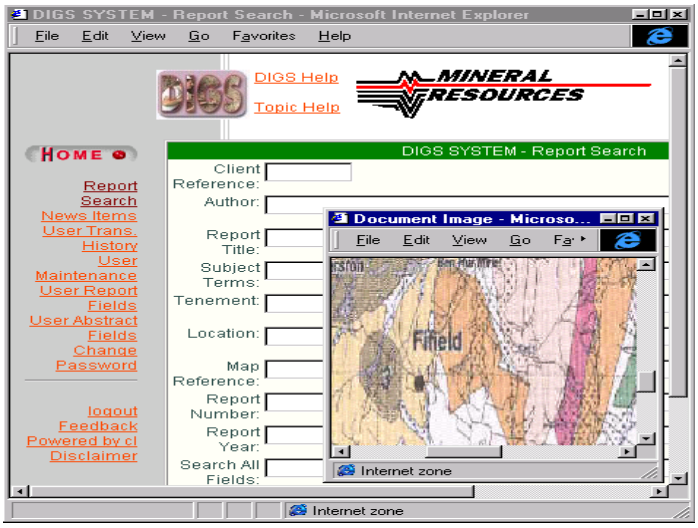
An "Account" user is a frequent user of the DIGS System, who wishes to view and down load images or digital data from the reports. The account user is provided with an account name/number, userid and password. Once these have been provided the user can access the images and digital data for the reports. The account user must be registered with the Department.

Searches can be conducted on the Internet version of the DIGS system through a text searching mechanism (figure 5) similar to that developed for the system used on the Departments WAN. (see Quarterly Note 109 p 8)

Due to the unpredictable nature of the Internet and the possibility of not delivering data DIGS on the net has been designed to allow the account user to check on the status of requests made on the system via a function call the user transaction history. This allows the account user to

a) View details and images for a transaction called previously.
b) Check the status of an image, for example, if a digital document has been selected for delivery by e-mail, then the system will report on the status of the e-mail request.
c) Change the way transactions (requests) are sorted. Requests can be sorted by date, or by a user defined reference number.
d) Gives totals for all functions.

Figure 5 The DIGS Internet Search Screen showing a degraded "Internet" colour images of a geological map.



Linking DIGS with COGENT

The Department has and is continuing to develop a number of geoscience data sets as part of its Cogent (Common Geoscience Environment) project. The data present in the corporate database includes metallic mineral occurrences, industrial mineral occurrences, landuse dealings, fossil locations, geochemical assays results, isotopic ages, field observations, drilling, rock names, petrology descriptions, and metadata (datasets, products and projects).

At present corporate databases are accessed via a web page on the Department's Intranet site. There are future plans to release a customised, and in some cases restricted, view of the data onto the Internet. These data sets comprise a combination of meta-data (summary data) and in some cases complete populated tables. For those data set containing only meta data such as the Intersect (drilling database) it is

possible to link these data sets with the scan image of a drill log or location plan in the DIGS System.

The ability of DIGS to identify particular documents allows the integration of DIGS with spatial delivery systems, allowing spatial queries to being linked to located objects (titles, drill sites, surveys) with a document (images or digital data). The spatial identification of particular documents allow the searching and delivery of both the actual data (map, drill log) and the associated meta-data eg summary drilling data.

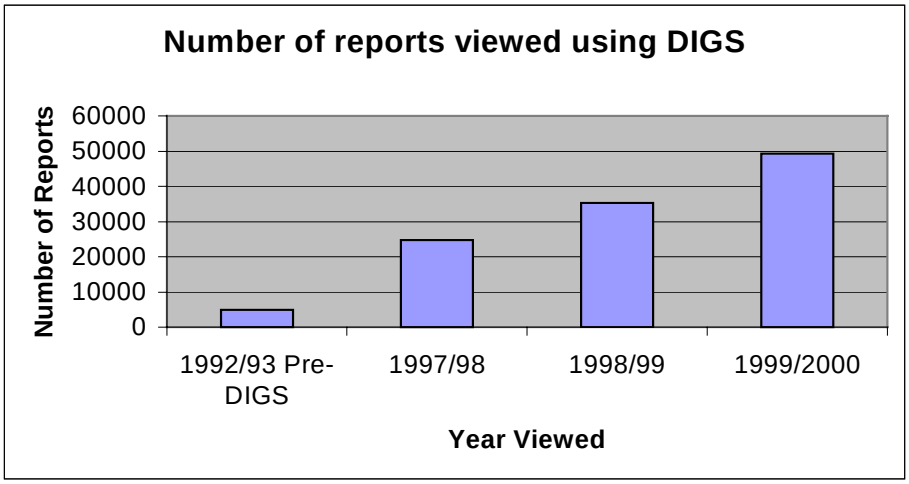
This concept of delivery of data from summary data provides the advantage that the Department does not have to collect state wide data to the level of individual or specific data points (which has the potential to save costs in data collection) and therefore completely populated tables to get specific data. Data collection has to be at a summary level and point to the actual data that resides in the DIGS system. This could be in the case of DIGS a scanned image or with newer reports the actual digital data set. The disadvantage is that the data is not collected to a very low level but only to a high level summary (meta-data level). This means that manipulation of data could only be done at a high level and complex analysis of low level data would not be possible.

DIGS Internet Usage

DIGS on the Internet was launched on the 17 February 2000. Since this date Account Users have access the system from as far away as Canada, USA, Japan, Ireland.and Russia. As recognised by Brookes G (1993) users of the DIGS (GS report system) can be placed in four main categories: companies and/or, consultants, universities, government Departments and general public and internal staff.

Usage of the DIGS system has increased steady. The figure 6 below shows the usage of DIGS from all access points. The 1992/93 figure is the client usage using the old paper based system.

Figure 6 Report usage before and after DIGS implementation

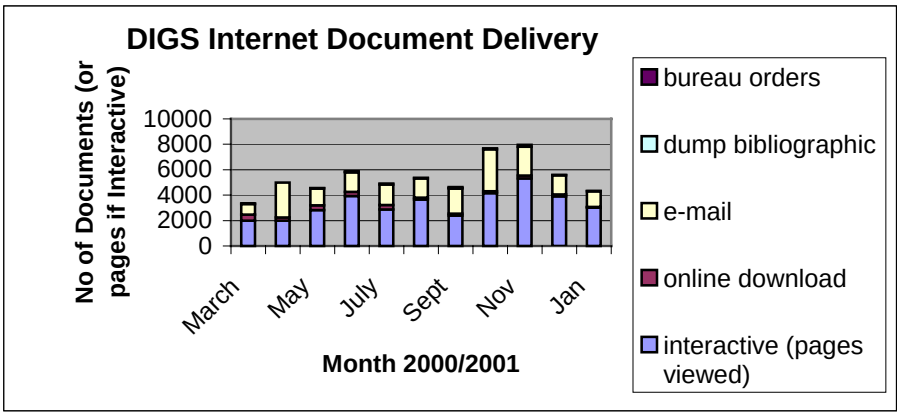


The profile of DIGS users has changed with deployment of DIGS over the Internet. The system has developed a number of new clients and is providing key source data to organisations that have never accessed the system in the past. For example, in 1992/93 students from 8 universities accessed the reports. Since DIGS was placed on the

Internet over eighteen universities have students accessing DIGS. These include universities from China, United Kingdom and Iran.

The figure below indicates the methods clients are using to view and obtain image and digital from the DIGS Internet system.

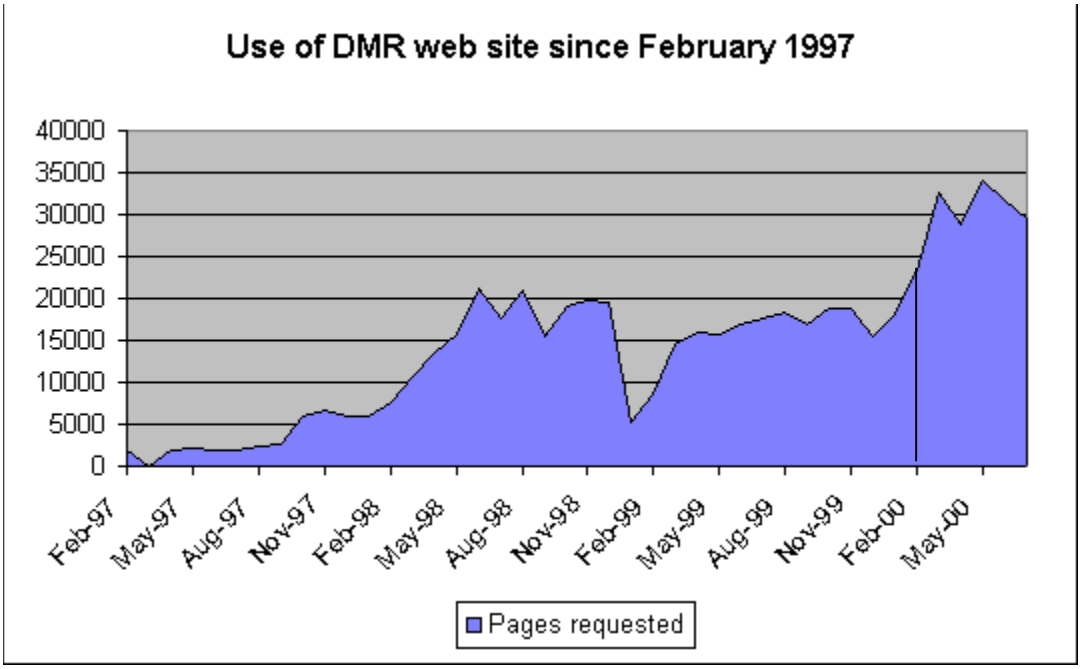
Figure 7 Delivery mechanisms used to deliver document across the Internet



This table indicates that many clients are viewing data and then requesting images to be sent via e-mail. This could indicate that clients are browsing the system, identifying component parts of the reports and having them sent by e-mail allowing them to continue using the system avoiding the delay caused by a down load via the browser.

The impact of DIGS on the Departments Web site has also been significant. Since DIGS became available on the web site since February 2000, the increased usage of the Departments site is evident. (see figure 8). A recent client survey of over 500 clients indicated that the DIGS Internet Interface was the most useful system on the Departments web site.

Figure 8 DIGS was placed on the Departments Internet site in February 2000



Data Source B Harris Departments Web Co-Ordinator (DMR)

Conclusion

The DIGS Internet project is a unique application of imaging, digital document management and full text retrieval integration applied to a wide range of document types. DIGS is one of only a few Geoscience Internet systems of its type so far implemented in the world.

The current application is being updated and adapted to allow for new search functions and integration into other information systems. This integration into others systems such as the growth of DIGS with the Departments Cogent databases will allow the growth and development of relationships between databases within the Department allowing full interactivity between databases within the Department and eventuality on the Internet.

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Fifth National Forum on Information Management in the Geosciences:
Geoscience On-Line
28th to 29th March 2001

Developing a GeoServer for Delivering Geoscience Spatial Data On-line for Primary Industries and Resources, South Australia

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ABSTRACT

The Department of Primary Industries and Resources, South Australia (PIRSA) is developing a GeoServer Website to deliver geoscience and other spatial datasets held by the Department across the world wide web. The initial stages of the project will deliver on-line mapping functionality to two business areas: Mining exploration tenement applications and licences through the South Australian Mineral Tenement Application System (SAMTAS) and the mineral industries through the South Australian Geoscience Information System (SAGIS). The project will deliver interactive mapping capability to the PIRSA website and develop the infrastructure for later development of other geoservers including an agriculture industries geoserver.

This paper will discuss the development of the GeoServer functionality within PIRSA to meet the business needs of the Department and its customers, as well as discussing the technical solutions required for the delivery. The paper will also address the future access and delivery of spatial data requirements of the Department covering e-commerce, data provision and technical issues.

INTRODUCTION

The Primary Industries and Resources South Australia (PIRSA) is the custodian of a large amount of spatial information that is a crucial asset in attracting investment and enhancing South Australia's economic development. The development of on-line services is seen as an important means of facilitating delivery of spatial information to the community and PIRSA staff.

PIRSA have commissioned the development of a system that will enable the delivery of spatial data across the Internet. Known as GeoServer, the system will serve spatial information from the mineral exploration, geological and agricultural business units. The first stages of the project is expected to be completed and on the Internet by the end of April 2001.

Three on-line 'modules' are planned to be established under the GeoServer project and are targeted at highly strategic Government customers that represent two of the State's largest industries; the agricultural and mining sectors. Specifically the GeoServer project is intended to provide on-line access to the following two business units:

South Australian Mineral Tenements Application System (SAMTAS)

The purpose of SAMTAS is to provide an electronic lodgement system for tenement application for the minerals exploration industry. The system will allow clients to initiate the application process for licensing tenements on-line.

South Australian Geoscience Information System (SAGIS)

The purpose of SAGIS will be to provide on-line access to selected high quality spatial information for the exploration and investment communities.

SOUTH AUSTRALIAN MINERAL TENEMENT APPLICATION SYSTEM (SAMTAS)

The SAMTAS module of the GeoServer project seeks to:

- Provide on-line access to spatial information relating to existing Mineral Exploration Licenses (MELs) and Mineral Exploration Applications (MEAs);
- Enable users to download spatial data relating to current MELs and MEAs (eg. ArcView Shapefiles and MapInfo TAB files);
- Present users with non-spatial information about MELs and the process of submitting a MEA (eg. text documents, tabular data, PDF files); and
- Allow on-line submission of applications for MELs. More specifically it is envisaged that users will be able to:
  - Define an area for which an MEL is sought via graphical (on-screen) means;
  - Pay appropriate fees and charges; and
  - Complete application form and submit on-line; and
  - Provide application details to the Mineral Exploration Licence Register package (MinReg) for automated processing.

The following concept diagram provides an overview of how SAMTAS will operate (Figure 1).

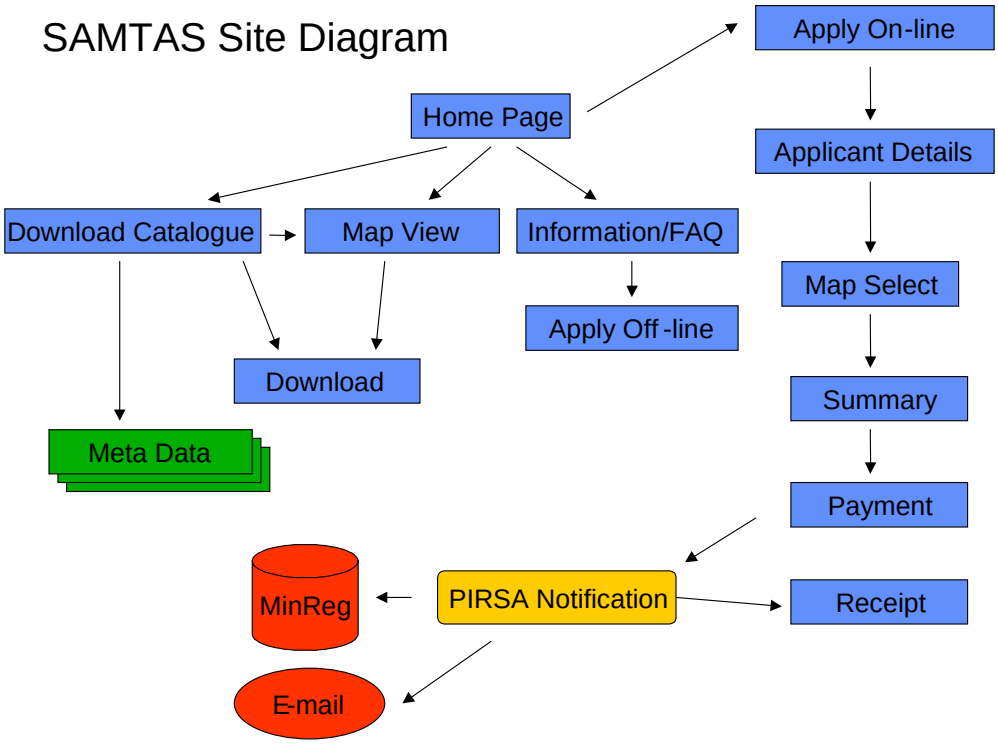

Figure 1: SAMTAS System Concept Diagram.

Currently, users wishing to apply for a mining exploration license do so by submitting an application form via post, fax or in person. The application form obtains details such as:

- General applicant details (name, address, company name, etc.);
- A general location for the area covered by the license application;
- A specific description of the application area in terms of the bounding latitude and longitude;
- A plan map defining the application area; and
- Specific information about the proposed exploration and the financial and technical ability of the applicant to undertake exploration.

The applicant must also pay an application fee at the time of submitting the application which is currently under AUD$200. Following submission of the application, PIRSA staff assess the details against regulatory requirements and a decision to grant or refuse the license is made. Applicants are notified by mail of the outcome of this assessment process. The existing manual application for MEL process is maintained in its entirety, and is proposed to be supplemented by the SAMTAS module, as shown in Figure 2.

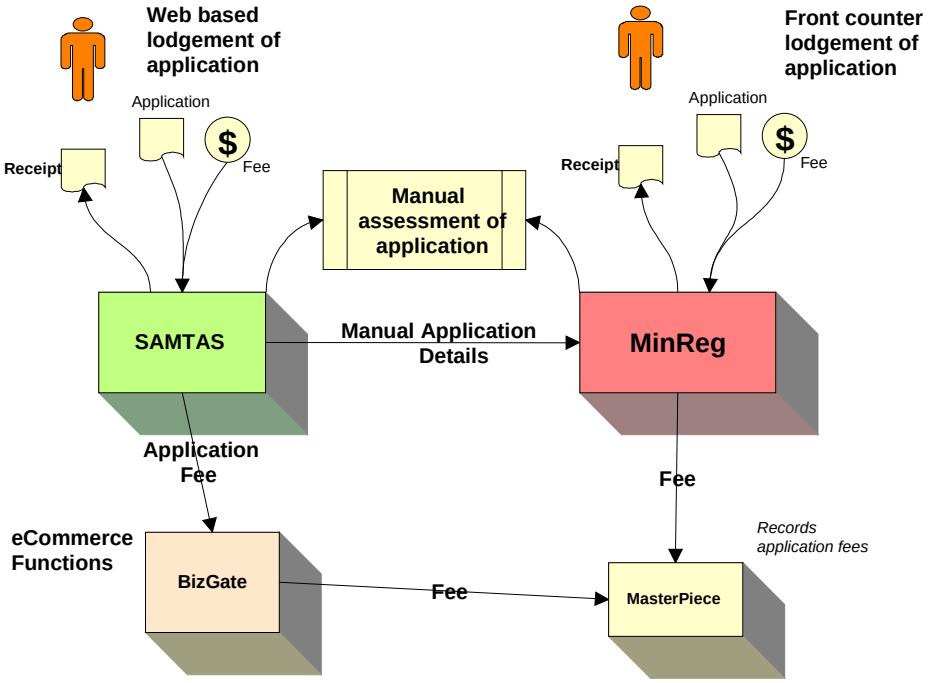

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Figure 2: Addition of web application to existing business processes.

Users wishing to apply for a mining exploration license via SAMTAS will be able to do so across the Internet. An application will be progressed through the following steps:

- Prepare application, consisting of the following tasks:
- SAMTAS user enters general applicant details (name, address, company name, etc.);
- SAMTAS user defines the general location for the area covered by the license application;
- SAMTAS user defines the specific description of the application area in terms of the bounding latitude and longitude, using on screen mapping tools to define the application area;
- Specific information about the proposed exploration and the financial and technical ability of the applicant to undertake exploration;
- Applicant must pay an application fee to confirm lodgement of the application. That payment can be made on-line through an e-Commerce process, or the applicant may choose to finalise lodgement through a traditional form of payment;
- On completion of the application and payment processes, the following tasks are performed by SAMTAS:
    - Application details and receipt information is provided to the applicant;
    - Application details and receipt information is forwarded to MinReg for automated processing; and
    - Application documentation is automatically forwarded to PIRSA staff for assessment.

The following diagram provides an overview of the existing and proposed Mining Exploration Lease application process. Figure 3 shows the integration of the geoserver and current system.

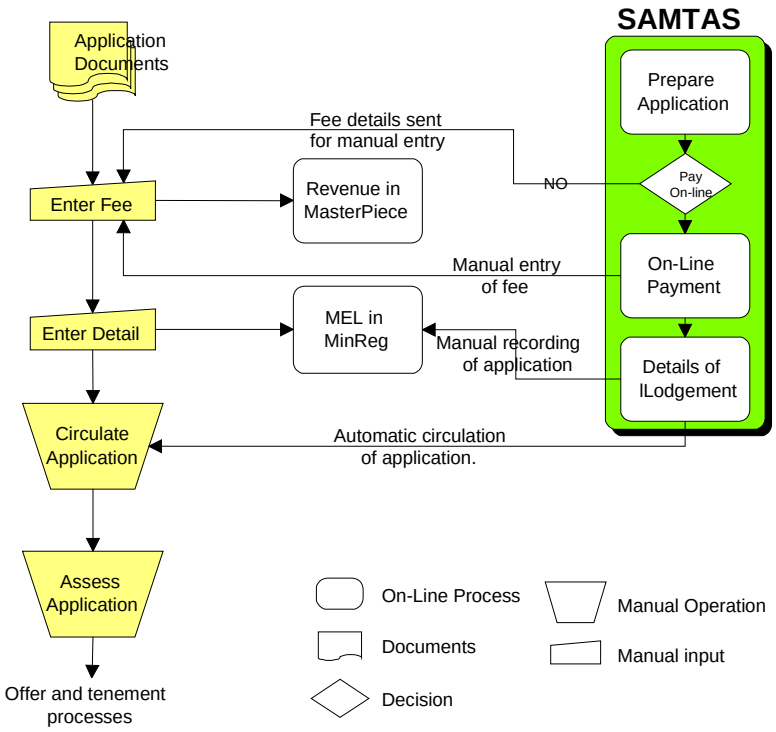

Figure 3: Current and future business processes.

Two business activities currently exist to aid in the implementation of the SAMTAS module. The first business activity is the current website and existing download functionality. To some extent the fundamentals of this system need little alteration. Users are already accustomed to on-line data and so will readily adapt to a new system offering increased functionality. From a back-office point-of-view the following improvements or additions may be required:

- Additional data management processes or procedures to update and synchronise download data and map-viewing data. The requirement will be to have the latest data on the PIRSA system available for download from the website;
- Processes or procedures to automate the updating of datasets with incoming applications. Whilst this currently occurs, the potential for increased numbers of applications may warrant a more efficient and manageable solution.

The second business activity that will aid in the implementation of the SAMTAS module is the existing application assessment procedure and associated systems. Potential improvement to existing processes may include:

- Process or procedure to manage non-spatial content of website (e.g. Price schedule, Metadata, support and general information); and
- Potential future benefit to customers in providing on-line tracking of application; and
- Linkage established between on-line application and the PIRSA financial reporting system (Masterpiece).

The potential benefits and costs of such improvements will need to be assessed prior to proceeding with indicated enhancements.

SOUTH AUSTRALIAN GEOSCIENCE INFORMATION SYSTEM (SAGIS)

In broad terms the functionality of the SAGIS module will be defined by:

- Provide on-line access to PIRSA's vector datasets that relate to mining and exploration activities with some access to non-PIRSA data;
- Enable users to download PIRSA's vector datasets;
- Allow users to view samples of PIRSA's raster datasets;
- Provide a catalogue of pre-defined CD data packages (vector and raster) that users may purchase;

- Permit users to order pre-defined CD data packages; and
- Accept payment for ordered CD data packages.

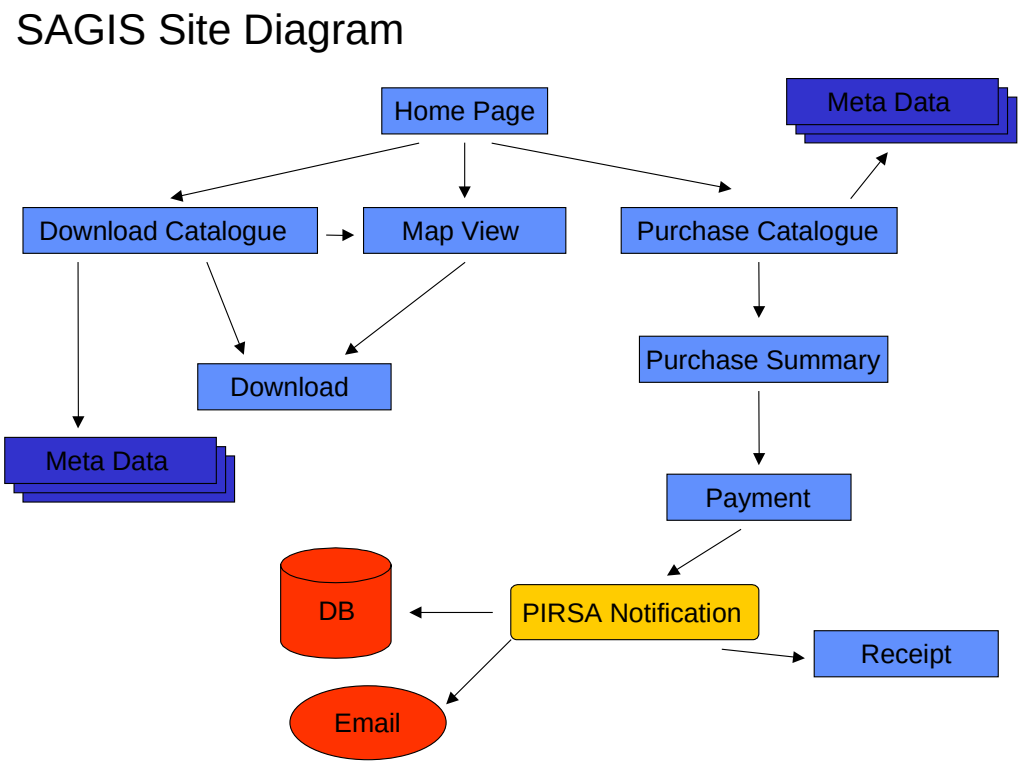

Figure 4: SAGIS system design diagram.

PIRSA currently offers spatial data for download and purchase from their website. The download function is presently limited to datasets related to minerals exploration licensing. Other datasets are available on CD and may be purchased by telephoning or e-mailing PIRSA staff directly. The current website delivery is essentially non-spatial in nature as users can only read descriptions of available datasets and view a static location map. There is no ability to view individual datasets prior to purchase.

Datasets specific to mineral exploration are currently provided in a range of formats:
- ArcInfo export format;
- ArcView Shapefile;
- MapInfo MID/MIF;
- AutoCAD DXF;
- Microstation design; and
- Dbase.

And projections:
- Geographical (GDA 94);
- UTM MGA Zone 52 (GDA 94);
- UTM MGA Zone 53 (GDA 94); and
- UTM MGA Zone 54 (GDA 94).

Users of the website are also able to download non-spatial data relating to mineral exploration licensing such as:
- List of current exploration license applications;
- List of current exploration licenses;
- List of current exploration license holders;
- Mineral tenement activity statements;
- Information about royalties; and
- Application forms.

These downloads are available as PDF documents.

At the present time few processes are in place to support the implementation of SAGIS functionality. To some extent the existing ordering system may be modified to facilitate on-line ordering. Process identified for potential improvement or processes new to PIRSA include:

- Linkage established between ordering and financial reporting (Masterpiece);
- Additional data management processes or procedures to update and synchronise download data and map-viewing data;
- Process or procedure to manage non-spatial content of website (e.g. price schedule, Metadata, support and general information); and
- Potential future benefit to customers in providing on-line tracking of orders.

OTHER APPLICATIONS

The GeoServer architecture is planned to provide the infrastructure for a number of other PIRSA applications over time. Table 1 lists a number of potential projects.

Business Group	Web Application	High-level Description
Sustainable Resources	Agricultural Sustainability Indices	Monitoring of agricultural health indices such as carbon, greenness, and rainfall, and a statewide service.
Sustainable Resources	Agriculture Industries GeoServer, (AGS).	Priority 1. - To provide online access to high quality regional spatial information services for the primary production, agricultural advisory and investment communities. Priority 2. - Nomination and downloading of user defined areas of regional spatial agricultural data. Priority 3. - On-line modeling and analysis of regional spatial agricultural data.
Sustainable Resources	Farm instance/event systems	Provide a system to facilitate the reporting, data collection, monitoring, and management of events such as locusts, notifiable diseases, or noxious weed infestations.
Forestry	Agroforestry Property Analysis	Develop web interface for existing Agroforestry Property Planning GIS package.
Mineral Resources	SAMTAS extensions	Priority 1. (Current development) Priority 2. - Public Notification and advertising of Exploration Licence application details on acceptance of the lease offer via the web.
Mineral Resources	SAGIS extensions	Priority 1. (Current development) Priority 2. - Nomination and downloading of user defined areas of mining industry spatial data. Priority 3. - Provide integrated access to PIRSA's Image data through SAMGIS.
Petroleum	PGS System	Provide a system (or incorporate as part of SAMGIS) to publish and order spatial industry specific data.
Petroleum	PEPS System web interface	Develop a GeoServer web interface for PEPS.
Petroleum	Environmental Register web interface	Develop an spatial web front end for the Petroleum Environmental Register
Corporate	Corporate GIS services.	Provide an integrated spatial data access and maintenance service within PIRSA.
Corporate	Spatial Information Integration Services	Provide spatial data sets access to the Spatial Information Integration Services infrastructure.

Table 1: List of potential GeoServer web applications.

The business process priorities as reported in Table 1 reflect the desires of the individual business groups, and are based on perceived benefits. In considering the above GeoServer based web applications, the following corporate applications were noted and described. Development of those corporate systems would be expected to greatly enhance PIRSA's ability to participate within the Information Economy, SIIS, and support the introduction of GeoServer type applications across PIRSA. It is further expected that there are potentially many other GeoServer based Internet applications that could be implemented within other PIRSA's business areas.

SYSTEM DESIGN

Technical Overview

The GeoServer technology will be based on the following solution:

- ESRI ArcIMS 3.0 to underpin the GeoServer system and will be used to serve spatial data to users across the Internet;
- Available spatial data will be accessed by the GeoServer system via ESRI ArcSDE and ArcView Shapefiles;
- User interface and system functionality (such as map browsing, selection of datasets, selection of mining lease areas, payment of fees, etc.) will be delivered via the Internet and achieved using a combination of Java, JavaScript and thin HTML/DHTML client;
- GeoServer system will be accessible from the existing PIRSA World Wide Web Site; and
- On-line payment for fees and services will be available to users through the SA Government's Bizgate e-commerce portal.

The architecture of the GeoServer system has two components including the system architecture and the GeoServer architecture. System Architecture addresses the connection between the World Wide Web and the PIRSA web server and addresses the connections involving the internal PIRSA web server, the GeoServer, E-Commerce functions and other databases. Figure 5 shows the System and GeoServer Architectures as they will interact in the GeoServer Project.

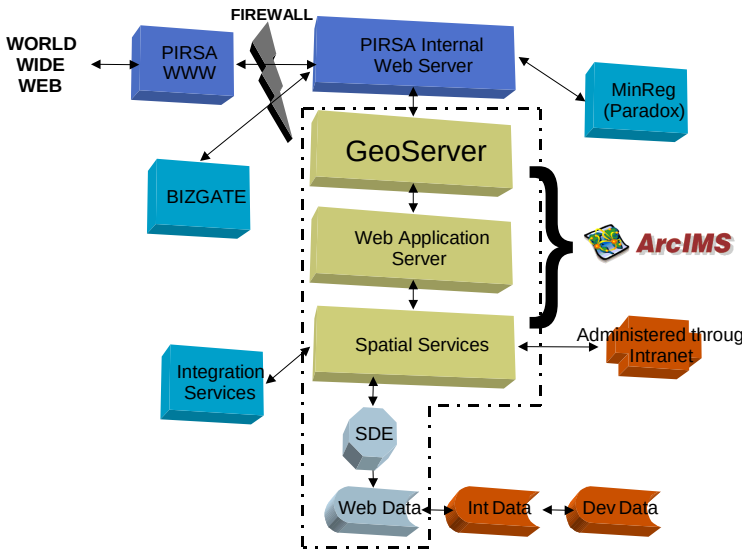

Figure 5: System and GeoServer Architecture.

Integration with existing Web Pages

To ensure that pages delivered from the GeoServer application reflect the current PIRSA 'web identity', navigation content (such as channel index, hotlinks, news items) from the Knowledge Network will be used to host a body of GeoServer content. The body of the web page (GeoServer content) will be generated by a combination of the web server and the GeoServer using ArcIMS. The standard web server will be used to create text pages, forms, and E-Commerce. The GeoServer will create the map-based content. This process is further illustrated in Figures 6a & 6b.

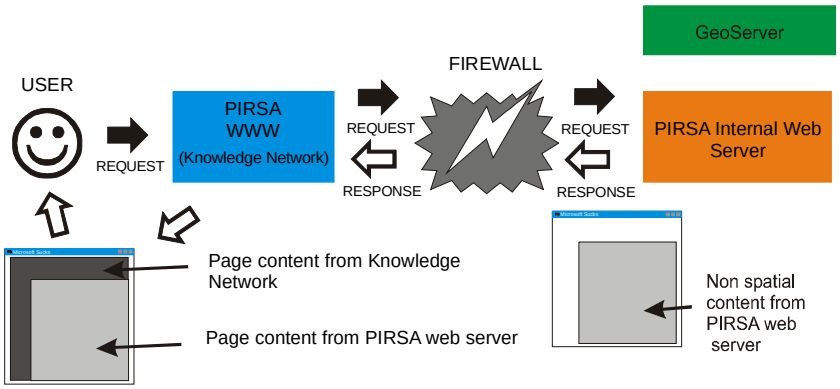

Figure 6a: Request for Web Page containing non-spatial information.

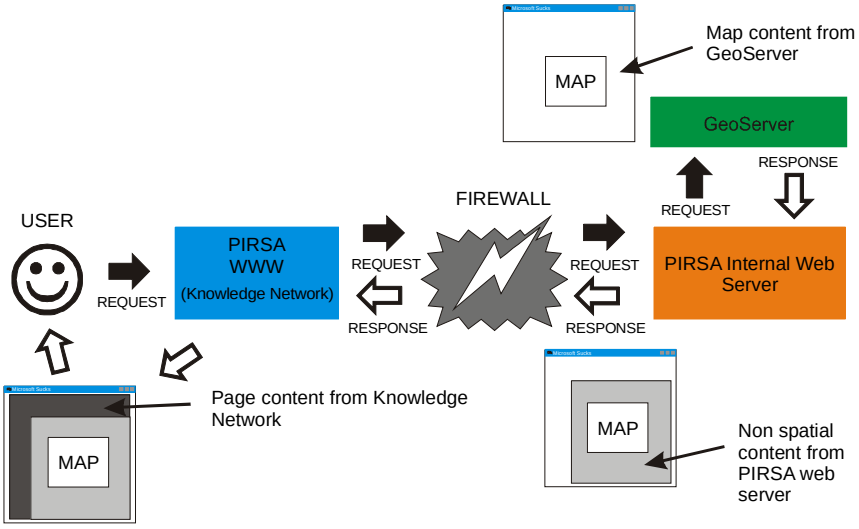

Figure 6b: Request for Web Page containing spatial information (map).

APACHE will be used for the standard web server which can handle HTML pages for producing standard web page content. The map-based content will be sourced from the GeoServer system and incorporated with content generated by APACHE using TomKat to link the ArcXML output from ArcIMS. These elements, when combined, will provide the page 'body' referred to above. Map content can be provided to the Web Server using HTML elements such as FORM or FRAME and an appropriate URL. Map content will be provided to APACHE as an autonomous page element, complete with user tools and functionality. Table 2 shows the main features of the GeoServer and System Architectures.

Component	Description
Internet	World Wide Web
PIRSA Corporate Web Server	Knowledge Network
Firewall	PIRSA's and EDS's firewall structure
PIRSA Intranet Web Server	APACHE Environment with TomKat
Bizgate	PIRSA Transaction Server linked to the ANZ State Government Bizgate for E-Commerce. PIRSA financial system (MasterPiece) will be used to track transactions
MinReg	Paradox Database for Mineral Exploration Licences and Mineral Exploration Licence Applications
GeoServer	Web Server for the GeoServer Map Content pages

Component	Description
GeoServer Application Server	ESRI ArcIMS 3
Spatial Services	SAMTAS and SAGIS etc
Administration of Spatial Services	ESRI ArcIMS Administrator internet application
Data Storage	ESRI ArcSDE
Integration Services	Link to State Government 'Whole-of-Government' Spatial Database Exchange Site
Department Data Store	In-house Data Server running ESRI ArcInfo with scripts to export and convert data to required formats MinReg Paradox database for Mineral Exploration Database

Table 2: GeoServer and System Architecture Components.

User Requirements

To develop the GeoServer the staff and customers of the new systems were involved in a number of user requirement workshops. The outcome of these were integrated into the detailed designs of the two systems. The following table covers the areas that had to be considered in looking at the user and system requirements.

- Structural Requirements including; location of SAMTAS module; navigation and site structure; and linkage between functional units;
- Data Requirements including: data types; data indexing; data format; metadata; data management; and non spatial data content;
- Display Requirements including: general display requirements; and map display requirements;
- Functional Requirements including: map query and selection functionality; map print functionality; spatial data administration functionality; spatial data download functionality; on-line application of mineral exploration licenses; and changes to existing systems;
- General Requirements including: security; backup/recovery; and audit and support requirements;
- Technical requirements including network infrastructure;
- Documentation Requirements: support requirements; training requirements; risk analysis and management options; and organisational and technical impacts.

Following the User Requirements stage a detailed design was prepared before the building commenced on the system. Once the development is complete a stage of implementation will occur with testing and user training to follow. Figure 7 shows a screen from the developing interface where the user is able to define the area they want for a Mineral Exploration Tenement. The figure shows the user adding points that are automatically snapped to the closest degree and all boundaries are forced to be orthogonal.

CONCLUSION

PIRSA's goals in delivering on-line services are to improve the return from the state's existing industry profile, to increase the investment by expanding the industry base, to promote responsible and sustainable development and resource management, and to promote rural community prosperity and adaptability.

The business objectives of the on-line services are to:

- Provide a pro-active data / information management approach to facilitate effective and open information exchange with customers and stakeholders;
- Establish a standard infrastructure and support framework for the delivery of on-line business services;
- Promote easy access and effective usage of stored data that can be integrated with subsequent database, records and knowledge management initiatives; and
- Provide support for a data sharing culture.

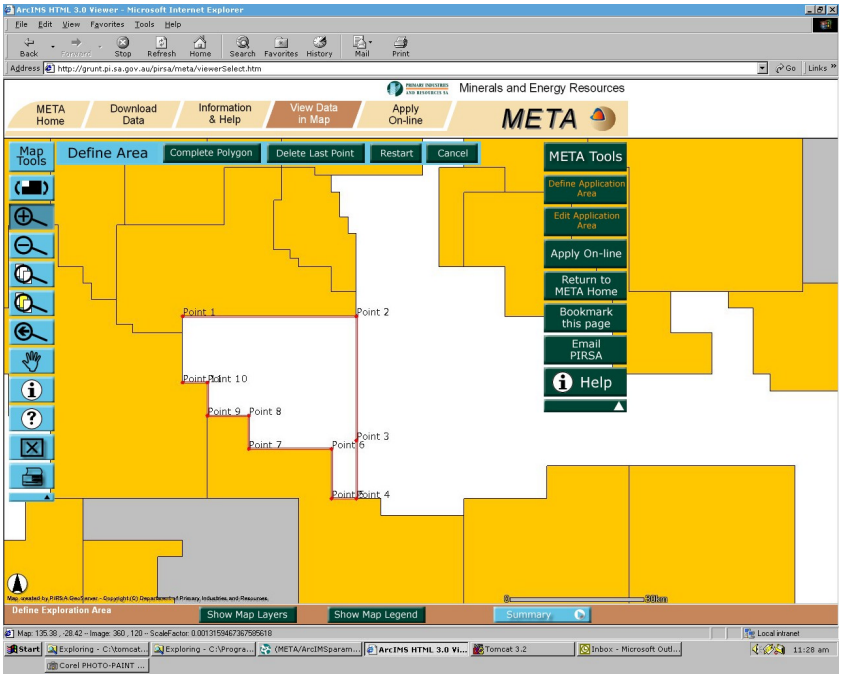

Figure 7: Screen image of the developing system.

The SAMTAS website will provide on-line services for the following:

- Identification of existing Exploration Licences and Exploration Licence Applications within the State;
- Lodgment of applications for mineral exploration tenement licenses;
- Payment for mineral exploration tenement license applications;
- User definition of geographic location and extent of license applications; and
- Access to spatial information.

The SAGIS website will provide on-line services for the following:

- Browsing of South Australian datasets providing mineral and topographic information;
- Download of digital data for use within client's software;
- Ordering of CD packages for specific geological regions within the state; and
- Payment of the CD packages ordered.

The GeoServer project will provide valuable knowledge on the development of online geoscience and agricultural services and will provide the framework for such services in the future.

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Web based mapping, GIS and image processing: the AGSO perspective

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The Australian Geological Survey Organisation (AGSO) presents its solutions to mapping, GIS and image processing on the Internet. Software used is based on commercial and open source products. A distributed web mapping system, using GIS data provided by six commonwealth government agencies is demonstrated. The development of the national geoscience datasets online GIS is discussed. This facility contains over 90 different GIS datasets and generates approximately 6 000 maps per week on the AGSO website. Current online systems integrating GIS data and database queries are also demonstrated.

AGSO has been providing Internet access to geospatial data since 1996. AGSO is the main repository for national geoscientific data, and services a wide range of clients across industry, government and the general public. Data provided range from point data, such as site descriptions and geochemical analyses of samples, to line, polygon and grid data, such as geological and geophysical surveys and associated maps. AGSO currently holds 800 MB of GIS data and a similar amount of image data on its web site; these data are expected to expand to a number of terabytes over the next few years.

A primary role of AGSO is to provide geoscientific data to clients and stakeholders in as efficient a way as possible, hence its choice of Internet delivery. The major obstacle for supplying data of large volume over the Internet is bandwidth. Many AGSO clients are in remote locations with low bandwidth connections to the Internet. Possible solutions to this problem are presented. Examples of AGSO web tools are available at http://www.agso.gov.au/map/.

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Australian Surveying and Land Information Group (AUSLIG): AUSLIG information management and distribution

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The Australian Surveying and Land Information Group is Australia's National Mapping Agency, responsible for the mapping, measuring and monitoring of the Australian continent and associated territories. AUSLIG incorporates the Australian Centre for Remote Sensing (ACRES) who acquire, archive and distribute remotely sensed imagery. This data is made available to industry and government for scientific and operational applications.

Rapid technological progress has engendered several market driven demands in respect of spatial data. AUSLIG has streamlined its products and services in order to meet these needs. Requirements for data in near real time are filled via the ACRES STAR service (Speedy Transmission after Reception), whereby imagery is acquired, processed and delivered electronically in a compressed format to the client within 12 hours of reception.

In addition, selected products and services are now available for access through the AUSLIG web site. SPOTLITE is a SPOT panchromatic mosaic of the Australian continent available for browsing and purchasing on-line via a digital catalogue. Similarly, The Gazetteer of Australia, a database listing geographical names and their locations, and the Australian Spatial Data Directory (ASDD) comprising metadata about significant national spatial datasets including digital and paper maps, remote sensing products and geodetic information, have been made available for access and use on-line.

AUSLIG has responded to market driven demands for higher accuracy of digital elevation data by revising the GEODATA product (9 Second Digital Elevation Model). Version 2 of the GEODATA product uses ANUDEM model 5.0, and includes additional data sources to enhance the accuracy of the product in comparison to Version 1.

Future programs include subscription services for the Raster 250K product, which is a compilation of digital images of all the 1:250000 scale topographic maps covering Australia. These advances are in direct relation to AUSLIG initiatives covering implementation of e-commerce and the integration of online access to Commonwealth geographic data holdings and will be covered in this presentation.

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Data Transfer and Standards-I

PDF: A “Pretty Damn Fine” Way to Deliver GIS Products Online

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A major change in the spatial industry over the last five years has been the increasing focus on the final stage of the GIS project – delivering the product to the user. This has been prompted by the increasing ubiquitousness of technologies such as the internet, web browsers, email and, as this presentation argues, the Adobe Portable Document Format.

Prior to PDF, the products of GIS projects or applications were hardcopy maps and reports, images or GIS data. Hardcopy maps were fine for their intended purpose but were not generally suitable for other uses. GIS data as a product required specialist software and knowledge to make further use of it. Images, although generically useable suffered from the trade of between low quality and large file sizes.

Adobe PDF and the free Acrobat reader software allows high quality (and highly compressed!) products to be easily delivered to users who can then view, print and manipulate these products with much more flexibility that most earlier product formats. This flexibility provides a quantum increase in the value of the product to the client which in some cases can act as a “mini GIS” in its own right.

This presentation will examine a variety of types of projects where Spatial Vision has used PDF to deliver product to clients. These range from more traditional mapping projects to web-based mapping applications and high-quality websites. Along the way we will look at various techniques for producing PDF files and some of the things we have learnt as a result.

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Delivering Spatial Products the PDF Way

Remember *GIS* 10 years ago? It was a "priesthood", practiced by a small number of backroom specialists using complex software. If clients were allowed to see or have any output at all, it was a pen plot using four (or if you were lucky, eight) colors and a confusing combination of cross hatches, or non-graphical outputs such as area statements. These outputs invariably ended up in a report, generally as a special insert or an appendix.

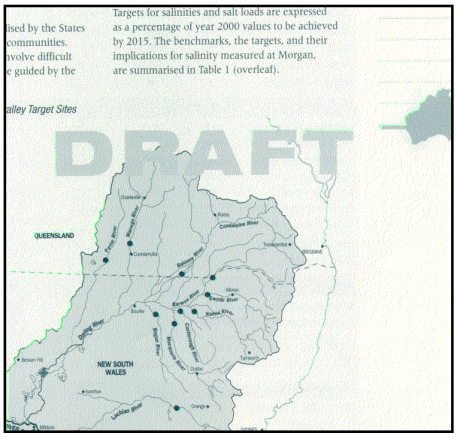
Arguably the most significant change over the last ten has been the enormous growth in the sophistication of the spatial products that end users can now receive. One of the most useful ways of providing spatial products, delivering high quality and functionality with ease of use and low cost, is the Adobe Portable Document Format (PDF).

PDF is a relatively new format that over the last few years has become the dominant format for delivery of a broad range of information over the Internet. One of the key reasons for its success was Adobe's decision to release the Acrobat reader software at no cost. Acrobat reader, either as a browser plug-in or as a stand-alone application, would have to be, apart from the browser, one of the most common pieces of free software on people's computers. Available for most computer types, it is now included in many large organisations SOE's (Standard Operating Environments).

Before I look at how PDF format can be used to deliver spatial products, let me first review the other main ways that such products have been delivered in the past and continue to be delivered today.

Maps and Reports

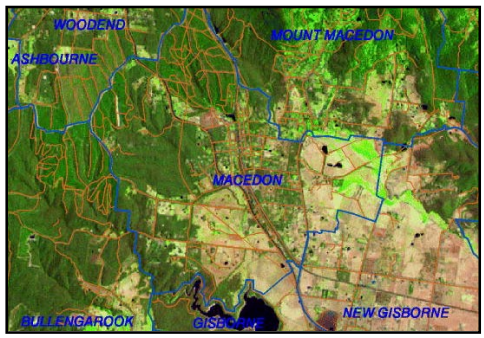
Maps are one of the oldest forms of information recording known to humans. Very early GIS was little more than a way of creating and maintaining maps in a digital environment, for ease of editing and reproduction. It didn't take long however, for people to realise the enormous benefits to be had from making the underlying data more intelligent.
Maps excel at presenting a focussed view of some information for a report. They can be optimised to highlight a certain feature



of the data and can be styled to suit their surrounds and intended audience.
Despite the advances in portable computers and PDA's, maps are still the most convenient way of carrying around such information, especially when weight, size and robustness are important.
Maps, however, have some limitations. They are generally expensive to produce, especially to publication quality. The information they contain is dated as soon as they're published and updating them is a costly business. They are also "single purpose" products and trying to use part of a printed map for another purpose is difficult. Despite this, I've seen people use a photocopier and a printed map to crop the map and rescale it, then copy it onto a transparency to overlay another printed map – a poor man's GIS.

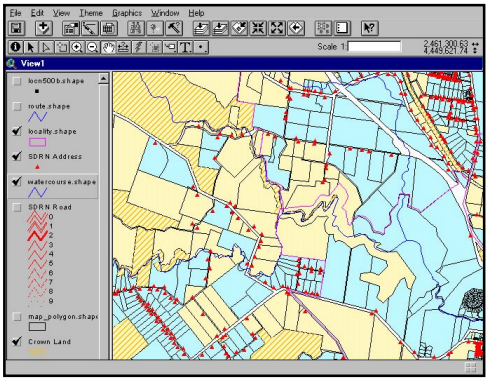
Images

Since most GIS software involves creating a screen display of the desired data prior to printing or plotting it, it wasn't long before people were capturing that screen display as an electronic image and forgoing the hardcopy map completely, at least for some uses.



These images could be sent to others digitally via disk or email and could then be viewed, enhanced, included in a report and printed. Furthermore, the end user of the image was not required to know about GIS, data, cartography etc. They could simply paste the image into their word processing document or PowerPoint presentation, perhaps cropping it to size first.
Such images had some problems however. The image files could be very large, especially if of a high quality. The map scale was fixed and if the image were enlarged to a different scale, the raster nature of the image resulted in a "pixelated" view that was unsatisfactory. Some GIS image formats such as BIL, also required specialised software to use them.

GIS Data
In the early days, the software and skill necessary to directly utilise GIS data made it useless for most end users. Over time however, desktop mapping and GIS software has fallen in both price and complexity and desktop computers have developed the power necessary to support such uses. It has therefore become much more common to provide GIS data as the output of a project. In the hands of a capable user, such data provides the highest level of flexibility and can be produced at any scale (subject to suitability), combined with other GIS datasets, symbolised to suit a variety of purposes or analysed to produce a range of information.



This flexibility comes at a cost. Apart from the hardware, software and training necessary to utilise the data, it can be difficult and time-consuming to create a cartographically pleasing product. If the end user is not fully aware of the limitations of the provided data, they can combine or analyse it in ways that can result in misleading information or maps. Finally, the provision of actual data can involve more complex and costly licensing arrangements than a "product" such as a map or an image.

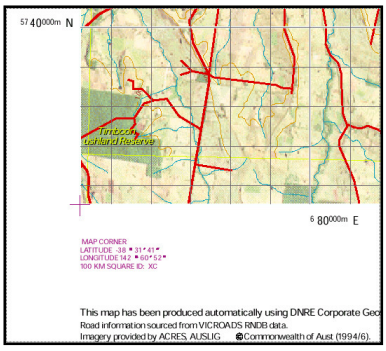
Adobe Portable Document Format
Adobe PDF is a file format derived from their Postscript® language which has been enhanced in a variety of ways, especially related to font, image and compression support. Teamed with the free Adobe Acrobat Reader, it delivers a result optimised for either viewing or printing across a wide variety of operating systems and hardware devices.

Although now very widely used on the web and elsewhere for presentation of text and graphics, for spatial purposes PDF has a number of specific benefits:

- it keeps the spatial data as vectors, allowing for optimal reproduction at any scale
- it provides good compression for image data
- font embedding ensures consistent reproduction, especially for the uncommon "symbol" fonts often used in GIS systems to symbolise point features
- the functionality of the reader software allows users to "pan and zoom" on a larger format map, two common GIS operations
- the "find" function in the reader software allows the user to spatially locate features on the map by searching for their text label
- PDF files are relatively easy and cheap to generate compared to paper maps

Example Project One: A Published Map Series
Published map series generally form the basis of a state's mapping effort and are used by a wide variety of groups for all sorts of purposes. The cost of publishing these series means that they are not updated frequently and owning a set (there are over 1,600 1:25,000 topographics maps to cover Victoria, and we're a small state!) can be prohibitively expensive.

In a recent project we generated a 1:100,000 and 1:25,000 map series to cover Victoria, converting all resulting maps to PDF format. These PDF files were then written to just two CDROMs, complete with some searching software that allowed the user to easily locate and view the map of interest. The resulting product is now being widely used in place of aging paper maps in a Vertiplan. Users can either print a large format copy of a map if they have a suitable printer or more commonly, can select a smaller area of interest and either print it to an A3 or A4 printer, or cut and paste it into some other application.



Of significant benefit here is that the maps can be updated as frequently as required and redistributed at minimal cost. It is also easy and cheap to add business themes to the base maps to provide maximum value to the end users. With the underlying processes in place, a new statewide map series can be generated with less than 2 days automated processing.

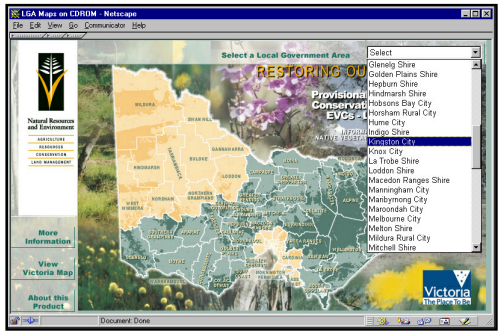
Example Project Two: Project Mapping Results

Another recent project initially had nothing to do with PDF. A new spatial dataset was derived for the client to show the status of vegetation conservation across Victoria (??). Some very detailed hardcopy maps were produced which met the client's needs well. A further requirement, however, was for this information to be made easily and cheaply available to local councils to assist their planning efforts. Furthermore, only half the state had been completed in the first stage, the rest was still to be done.

The solution was to generate the map series statewide as PDF files and package them onto a CDROM. Also required to accompany the maps was a range of explanatory information. Spatial Vision created a HTML "front-end" and packaged it onto the CDROM with the maps, then made the CDROM self-starting (see picture).

After a disclaimer, warning of the data's limitations and intended purpose, the user is presented with an opening screen showing a map of Victoria, a list of LGA's and a series of links to related information and help.

The user can either select an LGA from the list or click on the map. In either case, a new window opens up with the desired PDF map displayed.



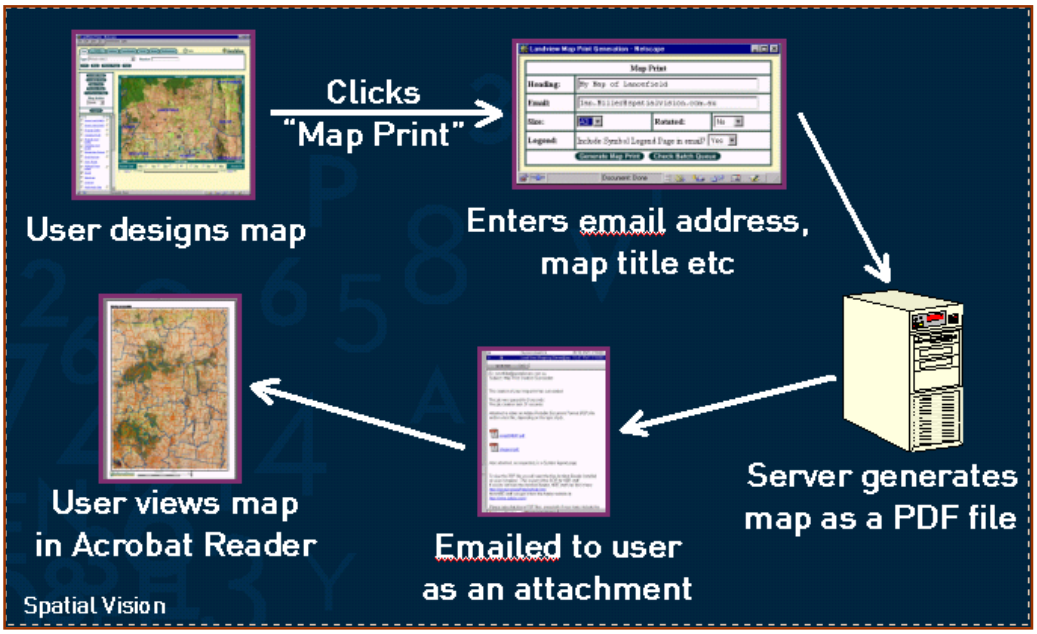
The only software required is a browser and the Adobe Acrobat Reader (which is included on the CDROM in case the user doesn't already have it installed).

This CDROM has been distributed to councils and will be updated as more of the state is covered.

Example Project Three: Web Mapping Application

Web mapping applications, both on the internet and on many organisation's intranets, are becoming very common. One thing missing in many of these applications is access to a high quality map product, with most delivering screen resolution images only. PDF is an excellent format to overcome this limitation, especially as it is the defacto standard for document delivery on the web.

In an intranet-based web mapping application we have developed, high quality PDF maps are generated by the mapping server based on the viewing parameters the user has defined by their onscreen map view. Having composed a



map of interest, the user clicks "Map Print". A dialogue window allows them to enter a map heading, email address and other details. The mapping server then generates a map and converts it to PDF. The PDF file is then automatically emailed to the user as an attachment. Once the user receives the email, they click on the attachment which opens up the Acrobat Reader displaying the map. This process takes between one and three minutes, depending on the complexity of the map and the mapping server load. (all of this is a diagram as well – or maybe instead)

The value of delivering the PDF via email is that it frees the user to get on with more mapping work, perhaps putting in a series of PDF map requests whilst the server generates them. The other benefit of this approach is that the mapping servers can be configured to give highest priority to generating screen maps and information, giving users the best possible interactive experience, with the more costly (in time) PDF maps taking a lower priority.
This seems to sit well with users – waiting even 30 seconds for an onscreen map to appear seems forever but having a PDF map arrive by email a few minutes later seems quite fast.

Generating PDF Maps
Most PDF creation starts with a postscript file. Many GIS packages can directly generate a postscript file. For those that can't, you can generally use the "print to file" option of a postscript printer driver to achieve the same result.
Once you have a postscript file, you typically use the Adobe Acrobat® software to convert (*distill*, in Acrobat terminology) the file into a PDF. There are also a number of public domain packages that can do the same things, with varying degrees of success, "ghostscript" being one of the most well known.

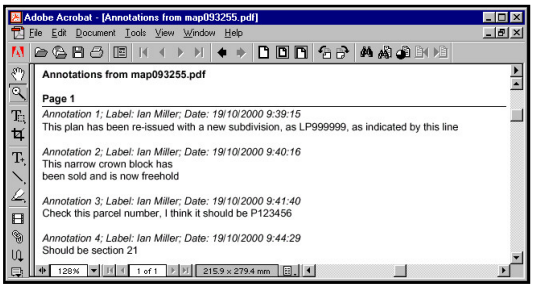
If you have Adobe Acrobat, these two stages can be combined into one via their "PDF Writer" printer driver. This allows you to simply "print" any map from your GIS software and end up with a PDF file in one step.

If you are creating your maps manually in a desktop GIS, you would generally run Acrobat interactively to create the PDF. This allows you to select settings to control things such as optimisation strategies, font embedding and security levels.
PDF files can be secured so that end users need a password to carry out actions such as viewing the file, printing it or copying sections of it.
You can also combine multiple map pages into a single PDF file, including explanatory pages, tables on contents etc – a real electronic atlas. You can also add links to areas of your PDF maps – linking to other PDF maps or to any web URL – great for links back to your website for further info, updates etc.

If you are creating your maps automatically, as part of an application, you need to first generate a postscript file from your map, then use the command-line driven Acrobat Distiller to convert it to a PDF file. Configuration files and command line parameters provide access to a similar range of options as the interactive version. Simple maps will distill in 10–30 seconds. Large format or complex ones (especially containing images) can take a few minutes.

Other Uses for PDF Maps
PDF files are an ideal way to archive map products. Not only are they highly compressed, but it is very easy to view, print and send them out at some later time.

Another great use for PDF maps is for data validation and map corrections. Using the full Acrobat product, users can add "annotations" to a PDF file. These annotations can include textual notations, simple graphics (lines, etc) and a highlighter which allows you to mark text in a fluorescent color. In addition, the graphic and highlighter annotations can also have notes added to them to explain



their meaning to the data maintainer.

The marked up PDF map can be emailed back to the data maintainer who can view these annotations, including looking at any notes behind each edit. The Acrobat Reader will also print out a convenient summary of all annotations on a page which can be a handy work list, showing who made the annotation and when, as well as the notes entered.

In cases where security is important, the annotations can be digitally signed to ensure the edits come from an authorised source.

PDF files can also have forms embedded in them, allowing the capture of structured information from the user which can assist the feedback and maintenance process.

In Conclusion
PDFs are a great way to deliver map products to the user. Not only are they easy and cheap to produce, but they give the user access to a wide range of functionality, increasing the value of the product to the user.

The ubiquitousness of PDF is its real selling point. It rise as a web standard means that most people will already have the reader software installed and be comfortable using PDF files. More importantly, the adoption of the software by many large organisations means that you don't need to fight the battle having a little known plugin or application approved by the IT department.

PDF will complement, not replace the other ways of delivering spatial products. Increasingly however, I believe it will become the format of choice for users.

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XML for geoscience data - a key piece in the online puzzle

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The expressive capabilities and widespread support for XML make it a good basis for representation and transfer of geoscience data. Community acceptance of a standardised XML based language for geology would offer benefits in a variety of areas, such as web-based data transfer and the simplification of import/export procedures for specialised applications software. However, XML is only a meta-language that provides components for the construction of a language useful for data. The actual tag-set and structures must be defined for each particular application, such as geology.

Various schema languages are available to control XML document content. But a data schema is merely the representation of a data model, targeted at a chosen syntax or storage method. So the task of developing a schema or tag-set for a particular purpose will ideally focus on the design of the application data-model, followed by a mechanical conversion to a schema.

To develop a model for geoscience data we start by examining existing models. These come from two areas: models developed for existing and specialised geoscience systems, and models that underpin generic systems for the management and manipulation of geospatial information.

Examples of geology specific models include:

- observational data from the exploration sector, such as drill-hole and assay data, various geophysics formats (seismic, potential field, active EM, etc.)
- models based on a higher level of inference, such as block-models and grade-control data from the mining sector
- highly interpretative models such as maps, which rely on additional components like stratigraphic columns.

In the geospatial area, ISO and the OpenGIS Consortium have developed a model to underpin the next generation of applications. The major achievement is the establishment of an object-oriented "feature" model of geospatial entities, largely replacing the map-oriented "coverage" approach. If we base our geoscience models on the feature model, we can build on the generic work already completed (e.g. in geometry), and also expect to maximize our potential use of DBMS, GIS, CAD and graphics software. The XMML project, based at CSIRO Exploration and Mining, is taking this approach.

The feature model is a good match with the classic approach to geology, allowing focus on named objects such as "fault", "sample" or "ore-body". Nevertheless, there are a number of problem areas which will require additional work, such as gridded and continuous-field data (in 1-D, 2-D, & 3-D), 3-D geometries & topology. Another issue is that the model requires each feature to be assigned to a *feature-type* prior to description. While this may be adequate for a "snapshot" of a model used in transfer, such early-binding of types may conflict with a more scholarly approach, in which the classification follows the description, and may be modified in light of later discoveries or conceptual developments.

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Suitability of SVG for Online Geospatial Applications

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Scalable Vector Graphics (SVG) is a language for describing two-dimensional graphics in XML. SVG has recently gained wide acceptance as a standard for vector graphics after an incubation period of nearly two years under the guidance of the World Wide Web Consortium.

Many pre-existing vector formats have their origins in a specific domain such as GIS, CAD/CAM and Desktop Publishing and have limitations when applied to other areas outside their domain. With the prevalence of the Web and the increase in data sharing and interoperability there has been a growing and urgent need to develop a single standard for defining vector data for use in the Web environment across a wide range of applications.

For this reason the World Wide Web consortium formed the SVG working group to develop a specification. We will take a look at SVG and its relevance to geospatial applications. More importantly, we will discuss what are the most useful features and what are the limitations of SVG when used in the Web environment to describe geographic data.

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Data Transfer and Standards-II

E-business in spatial data: Policy and legal issues

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With the advent of the internet more and more 'business' is being conducted on-line and electronically. This presentation addresses the vexed questions of how to manage the delivery of data on-line as well as controlling the distribution and value-adding to the data. These questions raise policy and legal issues.

For example, the delivery of data on-line brings about the question of liability where the data become corrupted and error-ridden. To what extent are data providers liable for the error; that is, how far down the chain does one sheet home liability where the data error has caused loss and damage in third parties. What is the nature of the contract between the buyer and the seller? Does the seller has a statutory right to sell the data? This question is one where there is a migration of public data into the private arena and raises other policy issues: are private purchasers paying for data that has already been paid for through the tax system? What policies are best for small markets – cost recovery, cost of media only, custodianships, *gratis*? Do we wish an 'open records' policy such as in the United States in order to reduce risk of litigation?

Data broking and data warehousing provide good conceptual paradigms for centralising spatial data so that they become readily available when required. However, this may raise the metadata issue of how best to describe the data and will such descriptions help facilitate the e-business? Other legal issues include those of privacy, security as well as ownership such as in intellectual property. This discussion will draw upon experiences in Australasia as well as from the UK, Europe and the US.

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Towards an Australian Disaster Information Network (AusDIN)

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The vision of AusDIN is to provide timely and relevant information to assist emergency managers in implementing measures that reduce the impact of natural hazards on the Australian community. The context for this vision was the perceived need to better utilise information available from government agencies in emergency management decision-making processes.

It was intended that the system should address both short term (response) and long term (planning) activities. The scope of the system may need to be extended to include a range of man-made hazards. People involved in emergency management tend to be focussed on the response phase of managing the emergency. The information requirements for this phase are largely met from State/Territory or Local Government sources. There is generally a very poor understanding of the nature and availability of information available from other sources, including Federal Government agencies and private sector organisations. There is also a surprisingly low level of utilisation of information analysis and presentation systems including the use of information management and geographic information system techniques.

Although the culture of the emergency management community is gradually changing to accept the need for longer term planning or mitigation activities, this area typically remains grossly under-resourced. A number of initiatives are in place which address these aspects of emergency management, including the AGSO Cities Project and an increasing emphasis on mitigation in Federal Government relief funding projects. In order to improve the utilisation of (geo-)scientific information by emergency managers, AGSO commissioned us to undertake a Feasibility Study during the early part of 2000 which addressed the need for an AusDIN and how it might be developed. We developed a Concept Document which was used as the basis for discussions with State/Territory emergency managers and Federal Government agencies with a potential interest in AusDIN.

There was keen interest shown in the concept by emergency managers who were more committed to the need for planning and mitigation. A Draft Report was presented to the National Emergency Managers Executive Group (NEMEG) on 19 April 2000 where it received very strong support. The Final Report was presented to AGSO in June 2000.
Since the April 2000 meeting of NEMEG, there has been a sea-change in the groups which coordinate emergency management between State/Territory and Federal Government agencies. Although continuing initiatives are being driven from various Federal Government agencies, a much more cautious approach is being adopted by State/Territory agencies. The rate of progress in developing AusDIN is likely to remain slow until the new procedures have been fully developed and accepted.

A meeting of interested persons was held at EMA's Mt Macedon facility in December 2000 aimed at establishing a more general acceptance of the need for AusDIN and to determine the benefits of the proposed system to those involved in emergency management. Copies of our Draft Report and other documents were made available to participants. A lively and interesting discussion took place and some progress was made towards the objectives. However there has been little subsequent activity other than the development of a prototype website.

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GGIPAC REPORT

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The Government Geoscience Information Policy Advisory Committee (GGIPAC) is a working group of the Conference of Chief Government Geologists (CCGG). It provides advice to CCGG on matters relating to the coordination of database and geo-thematic mapping conducted by government agencies. In particular the Committee works towards consistency in geoscientific data such as data transfer standards, metadata and improvements to access and delivery systems.

The presentation will take the form of a report on the recent GGIPAC meeting held on 26, 27 March 2001, explaining what the current work program entails as well as offering some thoughts as to what might be included in the future work program.

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Fifth National Forum on Information Management in the Geosciences: Geoscience OnLine

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Future Developments

Online geoscience information: where to next?

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The collapse of the dot-com boom has left many wondering where the substance was in the much-vaunted e-Revolution. From an AGSO perspective little has changed, the benefits of online delivery make as much sense now as they did in 1993 when AGSO built its website.

In the period since 1993 the number of data types delivered online, vector, raster, real-time, etc, has grown, as have the number of inline processing applications and the number of vendors serving data. Client use has grown too, to the extent that thousands of geoscience map views are delivered online every week to clients around the world. In the future, closer integration between data vendors, via interoperable, peer-to-peer systems, and new technologies involving mobile and embedded computing, will see further development of online delivery within the geoscience sector.

Ultimately, if we can get past the initial hurdles of standards development, the promise is cheaper, more efficient management of the higher volumes of data and information that the sector needs to progress. The revolution has come and gone, now for evolution!

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